



Industrial & Commercial Vehicles

Burden Carriers

BC3-21 to BC4-45XB



Operation and Maintenance Manual
With Illustrated Parts List

Dear Owner,

Congratulations on your purchase of Columbia Industrial & Commercial Vehicle Model Burden Carrier. At Columbia Industrial & Commercial Vehicle, we pride ourselves on manufacturing electric personnel and burden carriers that are second to none in terms of designs, quality of materials, and workmanship. While our vehicles are designed and built for maximum efficiency, durability, performance and safety, proper maintenance and operator knowledge will nevertheless play a vital role in your long-term product satisfaction.

Thus, the information in this manual should be closely read, studied, and understood prior to operating your vehicle. If you do not clearly understand any portion of this manual, see your authorized Columbia Industrial & Commercial Vehicle Dealer for clarification. The manual contains the most current information available at the time of publication. However, as our Research and Engineering Department continually work to improve our products. It is possible that models produced subsequent to the publication of the manual may include improvements that are not referenced in this manual. Our Dealers can advise you of any updating of our recommended service and maintenance procedures that may have transpired subsequent to your purchase.

Should you have questions or encounter problems which our Dealer is unable to answer or resolve, we encourage you to contact us at the address below:

Columbia ParCar Corp.
350 N. Dewey Avenue * P.O. Box 30
Reedsburg, WI 53959
Phone: (608) 524-8888 * Fax: (608) 524-8380
(800) 222-4653 * Web: www.parcar.com
E-Mail: info@parcar.com

Your decision to invest in a Columbia Industrial & Commercial Vehicle is very gratifying to us and we wish you many years of satisfaction

FOREWORD

This service manual has been prepared with two purposes in mind. First, it will introduce the trained maintenance professional to the latest field-tested and factory-approved major repair methods. Secondly, it will acquaint the reader with the construction of Columbia Industrial & Commercial vehicles and assist him/her in performing basic maintenance and repair. We sincerely believe that this manual will make your association with Columbia Industrial & Commercial Vehicles more pleasant and profitable.

In addition to the information given in this Operation, Maintenance, Service and Parts Manual, Service Bulletins are issued to Columbia Industrial & Commercial Vehicle Dealers from time to time, which cover interim engineering changes and supplementary information. Service Bulletins should be consulted for complete information on the models covered by this manual.

To insure the safety of those servicing Columbia Industrial & Commercial Vehicles, and to protect the vehicles from possible damage resulting from improper service or maintenance, the procedures followed in this manual should always be followed exactly as outlined. Execution of the procedures and troubleshooting tips as outlined will ensure the best possible service from the vehicle(s). To reduce the chance of personal injury and/or property damage, carefully observe **NOTES, CAUTIONS, WARNINGS** and **DANGER** recommendations through out this manual. See chapter 1 for additional detail.

PREPARATION FOR SERVICE

Proper preparation is very important for efficient service work. A clean work area at the start of each job will allow you to perform the repair as easily and quickly as possible, and reduce the incidence of misplaced tools and parts. Columbia Industrial & Commercial Vehicles that are excessively dirty should be cleaned before work begins. Cleaning will occasionally uncover trouble sources. Tools, instruments and parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is a needless delay. Special tools required for a job are listed at the front of each section.

MODEL IDENTIFICATION

Always give the full vehicle identification number when ordering parts or making inquiries about your Columbia Industrial & Commercial vehicle.

Use of the full and complete vehicle identification number (VIN) information will assure your dealer or service provider is supplying you with the correct parts for your vehicle. See chapter 1 for vehicle identification information.

USE GENUINE REPLACEMENT PARTS



WARNING: When replacement parts are required, use only genuine Columbia Industrial & Commercial Vehicle parts or parts with equivalent characteristics including type, strength and material. Failure to do so may result in product malfunction and possible injury to the operator and/or passenger.

To ensure a satisfactory and lasting repair job, follow the service manual instructions carefully and use only genuine Columbia Industrial & Commercial Vehicle replacement parts. This is your insurance that the parts you are using will fit right, operate properly and last longer. When you use genuine Columbia Industrial & Commercial Vehicle parts, you use the best.

PRODUCT REFERENCES

When reference is made in this manual to a specific brand name product, tool or instrument, an equivalent product, tool or instrument may be used in place of the one mentioned.

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About This Manual

This manual contains information to safely operate and maintain the Burden Carrier manufactured by Columbia Industrial & Commercial Vehicles. Only trained maintenance professionals should repair or service this vehicle. Persons doing even simple repairs or service should have working knowledge and experience in general electrical and mechanical repair. Follow all procedures exactly and observe all warnings and cautions stated in this manual. Use caution and common sense.

It is also necessary that every individual who will operate this vehicle receive adequate training that assures the safe operation and use of this particular vehicle. This manual contains the following major chapters:

Chapter 1 INTRODUCTION

Contains Warnings, cautions, a description of the Burden Carrier, important information about taking delivery of the vehicle and lifting instructions.

Chapter 2 OPERATOR INFORMATION

Provides safety rules and guidelines, describes the driver training program, explains the operation of each control, operating instructions and storage of the Burden Carrier.

Chapter 3 MAINTENANCE / SERVICE

Shows a scheduled maintenance checklist, lubrication instructions, and minor maintenance procedures.

Chapter 4 ILLUSTRATED PARTS LIST

Includes an exploded view illustration and detailed parts list for each assembly or component group that has replaceable parts for the Burden Carrier.

Chapter 5 ELECTRICAL TROUBLESHOOTING

Includes any additional information that we may receive from our vendors on the components of the Burden Carrier and/or troubleshooting flowcharts.

These vehicles **are not** designed for over-the-road use. They do not conform to Federal Motor Vehicle Safety Standards or EPA regulations, and are not equipped for operation on public streets, roads, or highways.

To the best knowledge of Columbia ParCar Corp., the material contained herein is accurate as of the date this publication was approved for printing. Columbia ParCar Corp. is not liable for errors in this manual or for incidental or consequential damages that result from the use of the material in this manual. Columbia ParCar Corp. reserves the right to change specifications, equipment or designs at any time without notice and without incurring obligation.

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CHAPTER 1

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DANGERS, WARNINGS, CAUTIONS AND NOTES

Statements in this manual preceded by the words DANGER, WARNING, CAUTION or NOTE and printed in bold face are very important. We recommend you take special notice of these items.

It is important to note that some warnings against the use of specific service methods, which could damage the vehicle or render it unsafe, are stated in this service manual. However, please remember that these warnings are not all inclusive. Since Columbia Industrial Vehicle could not possibly know, evaluate and advise servicing personnel of all possible ways in which service might be done or of the possible hazardous consequences of each way, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Columbia Industrial Vehicle must first thoroughly satisfy himself that neither his nor the operator's safety will be jeopardized by the service methods selected.

! DANGER: Danger indicates an immediate hazard that will result in severe personal injury or death.

! WARNING: Warnings will indicate an immediate hazard, which could result in severe personal injury.

! CAUTION: Cautions indicate hazards or unsafe practices, which could result in minor personal injury, damage to the vehicle or to other property.

NOTE: Notes will provide key information to assure procedures are more easily understood or implemented.

It is Columbia Industrial Vehicle's specific recommendation that the following warnings must be observed at all times. Not all are repeated throughout this manual, but the recommendations included must be observed whenever these subjects (indoor vehicle operation hazards, gasoline and fuel system hazards, battery hazards, etc.) are encountered.

Be a safe operator. Electric Industrial vehicles are only as safe as the person who is at the controls. If accidents are to be prevented, and they most certainly can be prevented, operators must accept their full measure of responsibility. While the designer, the manufacturer and the safety engineer can help minimize the possibility of an accident; their combined efforts can be erased by a single careless act.

It is said, "The best kind of safety device is a careful operator." We ask you to be that kind of person.

! CAUTION: To prevent possible injury, always disconnect batteries before working on the vehicle. Remove both the positive and the negative battery cables as shown in Figures 1 and 2.

DISCONNECT METHODS:

Operational Installation: Standard

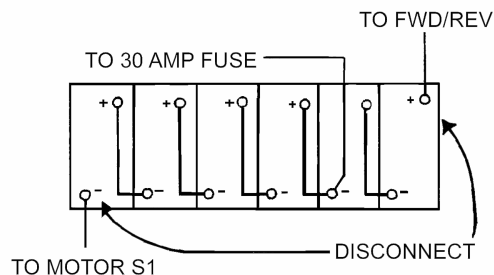
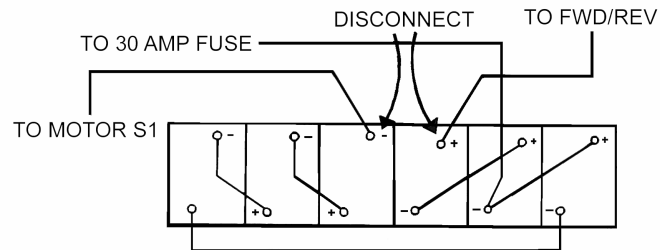


Figure 1 Standard Installation

Optional Installation: Push Pull Battery Pack



Note the Battery Polarity with this configuration

Figure 2 – Push-Pull Batteries Installation

⚠ CAUTION: No modifications or additions, which affect the mechanical or electrical integrity and the safe operation of the unit, shall be made without the written approval of the manufacturer. If in doubt about any modification, contact your local Columbia Industrial & Commercial Vehicle Dealer or Columbia ParCar Corp. Customer Service.

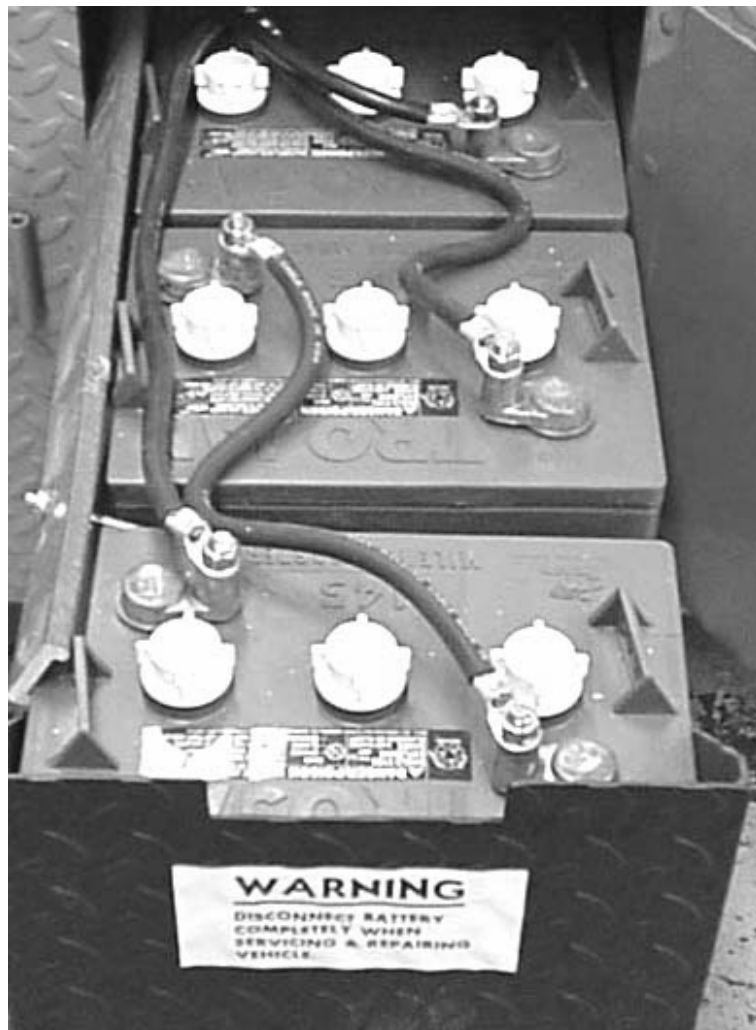


Figure 3 – Push-Pull Batteries Installed

ALL VEHICLES

 DANGER	➤ Any modifications or changes to the vehicle that affect the stability or that results in increased speed beyond factory specifications could result in severe personal injury or death. ➤ Always remove key and disconnect the battery(s) before servicing or repairing your vehicle. See Batteries, chapter 3 for details ➤ All batteries used in gas or electric vehicles can explode! Always wear full-face shield when working on or near batteries. Hydrogen fumes are a natural byproduct of charging and discharging and are extremely explosive. Do not smoke. Keep sparks and flames away from batteries. Battery charging should only be done in a well-ventilated area. See Batteries, chapter 3 for details. ➤ When working around or servicing batteries use care to prevent an accidental arc, which could cause an explosion. Use only approved insulated tools, remove jewelry such as rings, watches, chains etc. and place an insulating material (wood, plastic, rubber etc.) over all battery connections. ➤ BATTERY – Is poisonous! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. ➤ Antidotes: ➤ EXTERNAL: Flush with water. Call a physician immediately. ➤ INTERNAL: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately ➤ EYES: Flush with water for fifteen minutes. Call physician immediately ➤ If any problems are found during scheduled maintenance or inspections, DO NOT operate vehicle until repairs are made. Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.
 WARNING	➤ Only trained maintenance professionals should repair or service this vehicle. Persons doing even simple repairs or service should have working knowledge and experience in general electrical and mechanical repair. Follow all procedures exactly and observe all warnings stated in this manual. Use caution and common sense ➤ Proper service and repair is important for the safe, reliable operation of all Columbia Industrial Vehicles. The service procedures recommended and described in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. These special tools should be used when and as recommended. ➤ Moving parts hazard! When operating any vehicle in a stationary position, avoid spinning clutches, belts and wheels that could snag clothing or cause severe injury to body parts. A running vehicle must be worked on with the greatest care. Use caution and common sense. ➤ Working on Columbia Industrial Vehicles without following proper procedures and using proper lifting equipment may result in vehicle damage or personal injury. See lifting instructions in chapter 1 for detailed instructions. ➤ Failure to maintain vehicle properly could result in decreased vehicle performance, reliability or cause severe personal injury.

<u>ALL VEHICLES</u>	
 WARNING	➤ Any modifications or changes to the vehicle that affect the stability or that results in increased speed beyond factory specifications could result in severe personal injury or death
	➤ Always wear safety glasses or approved eye protection while servicing vehicle. Wear a full face shield when working with batteries
	➤ Exceeding rated vehicle load capacities could result in possible severe injury or property damage.
	➤ Always turn key switch to OFF, remove key, block tires and disconnect the battery negative (-) cable before performing any vehicle service to avoid accidental start-up of vehicle and possible injury
	➤ HOT! - DO NOT attempt to service hot motor or resistors. Failure to observe this warning could result in severe burns.
 CAUTION	➤ Cautions appear throughout this manual indicating possible hazards or unsafe practices that may result in minor personal injury, damage to vehicles or property.
NOTES	➤ Notes appear throughout this manual to provide key information to assure procedures are more easily understood or implemented.

Vehicle Description and Specifications

The Burden Carrier is a two-passenger vehicle involving cargo-hauling operation. This vehicle is designed to be driven on smooth surfaces in and around industrial plants, nurseries, institutions, motels, mobile home parks, resorts, etc.

This vehicle is not designed to be driven on public highways. The Burden Carrier travels on level surfaces at a maximum rated speed of 8 to 20 mph, depending upon vehicle battery voltage. Do not exceed this maximum rated speed. Exceeding this speed may result in steering difficulty, motor damage, and loss of vehicle control.

See Vehicle Specifications Table on page 1-7 for vehicle rated capacity. The vehicle identification label will indicate model and rated capacity. Do not exceed this rated capacity. This rated capacity includes optional equipment, cargo, passenger and driver.

This vehicle conforms to requirements for Type E vehicles as described in O.S.H.A. Standard Section 1910.178 (Powered Industrial Trucks) and with all applicable portions of the American National Standard for Personnel and Burden Carriers (ANSI B56.8 1993 Part III).

To insure prompt service when repairs or adjustments are required, your Columbia Industrial Vehicle Dealer must have the following information.

For your own personal reference, fill in the space provided below:

VIN# _____

The VIN Nameplate attached to the dashboard near the steering column indicates the power system, model code designation, and factory modifications/options. For security reasons the serial number is also stamped on the left square frame tube under the driver's seat.



This Carrier is Designed for 36 V (Normal)

Designed To Conform With The Mandatory Requirements Of
ASME/ANSI B56.8 Part III, ANSI/UL 583 Type E and
OSHA 1910.178

Reedsburg, WI USA

Figure 4 - VIN Name Plate

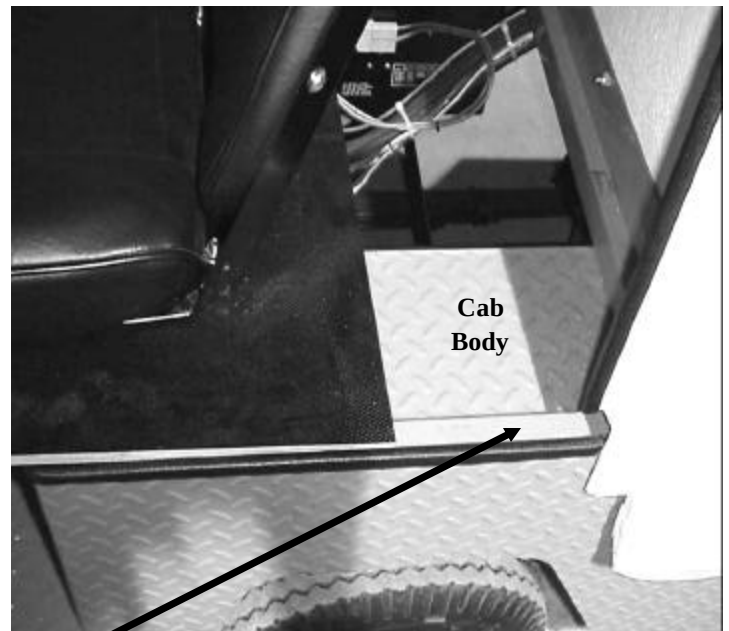


Figure 5 - Vehicle Identification Nameplate

VIN Number Locations

VIN Matrix

VIN PREFIX, FOUR CHARACTER SYSTEM			SEQUENTIAL SERIAL NUMBER	SUFFIX (WHEN USED)
1st Character Power System	2 nd Character Model Code Designation	3 rd & 4 th (when used) Factory Modifications/ Options	Five Numeric Characters	SP when used indicates this is a Special Vehicle having been significantly modified from the model indicated by the model prefix. It is critical when ordering parts for any vehicle with an SP prefix to give the entire VIN number to customer service to ensure correct service parts are ordered and shipped.
4= XP+ Power System	G= Burden carrier (62 inch bed)	D=48 volt Power System 8-6V batteries	12345	
	K= Burden Carrier (76 inch bed)	E=48 volt Power System 6-8V batteries		
		K=3000# (36 volt) or 2500# (48 volt)		
		L= 1700# (36 volt)		
		M=2100# (36 volt) or 1800# (48 volt)		
		N=4000# (36 volt) or 3500# (48 volt)		
		O=5000# (36 volt) or 4500# (48 volt)		
		X= 4 wheel hydraulic disc brakes Y= Rear wheel hydraulic disc brakes		

Burden Carrier Vehicle Specifications

Vehicle Specification Table					
Model #	System voltage	Rated Capacity	Towing Capacity	Maximum Speed	Bed Size
BC3-21	36 Volts	2100 lbs.	5500 lbs.	14.0 mph	62 inch series
BC3-30	36 Volts	3000 lbs.	9000 lbs.	11.0 mph	62 inch series
BC3-40	36 Volts	4000 lbs.	10500 lbs.	11.0 mph	62 inch series
BC3-50	36 Volts	5000 lbs.	12250 lbs.	7.0 mph	62 inch series
BC4-18	48 Volts	1800 lbs.	6500 lbs.	17.0 mph	62 inch series
BC4-25	48 Volts	2500 lbs.	10000 lbs.	15.0 mph	62 inch series
BC4-35	48 Volts	3500 lbs.	12000 lbs.	15.0 mph	62 inch series
BC4-45	48 Volts	4500 lbs.	14000 lbs.	14.8 mph	62 inch series
BC3-21XB	36 Volts	4500 lbs.	14000 lbs.	14.0 mph	76 inch series
BC3-30XB	36 Volts	3000 lbs.	9000 lbs.	11.0 mph	76 inch series
BC3-40XB	36 Volts	4000 lbs.	10500 lbs.	11.0mph	76 inch series
BC3-50XB	36 Volts	5000 lbs.	12250 lbs.	7.0 mph	76 inch series
BC4-18XB	48 Volts	1800 lbs.	6500lbs.	17.0 mph	76 inch series
BC4-25XB	48 Volts	2500 lbs.	10000 lbs.	15.0 mph	76 inch series
BC4-35XB	48 Volts	3500 lbs.	12000 lbs.	15.0 mph	76 inch series
BC4-45XB	48 Volts	4500 lbs.	14000 lbs.	8.0 mph	76 inch series

Note: All burden carriers are built to carry 2 people only and cargo.

Upon Delivery of your Burden Carrier

Note: This vehicle should be inspected immediately after delivery. Use the following guidelines to make sure there are no obvious problems.

Inspecting the vehicle

Examine the contents of all packages and accessories that may have come in separate packages with this vehicle. Make sure everything listed on the packing slip is there. Items should not be broken or damaged. Examine any visible wiring for obvious signs of damage. Check that all connections are secure. Check that battery connections are tight and all cells are filled to above plates. Inspect the tires for obvious wear or damage. Check for proper tire inflation; refer to manufactures recommendation imprinted on tire sidewall. Initial factory setting is between 35 to 50 psi. Make sure that all wheel lugs are secure. Check the body, seats, trim and other external parts for obvious damage.

Operate each of the following controls **BEFORE** turning on the key-switch:

- Accelerator Pedal for smooth operation
- Braking Pedal, assure presence of a firm pedal with minimal travel
- Directional selector lever
- Steering, check for responsiveness and little play
- Horn, check for proper operation

Each control should operate smoothly and easily without sticking or requiring undue effort.

What to do if you find a problem:

1. If vehicle has just been delivered, report any physical damage or missing items to the Shipping Company and your local Columbia Industrial Vehicle Dealer.
 - Look for body damage, jagged edges etc. that may cause personal injury.
 - Check for damaged or leaking batteries.
 - Verify fenders are attached properly, not bent out or are not protruding.
2. Consider what affect the problem has on the safe operation of the vehicle.
 - If the safe operation of the vehicle is affected, remove the vehicle from service until the problem has been corrected. Report the problem to the individual(s) responsible for correction and/or repair.
 - If the safe operation of the vehicle is not affected, record the problem and report it to the individual(s) responsible for correction and/or repair.
3. Report any service issue problems to the individual(s) responsible for correction and/or repair or contact your local Columbia Industrial Vehicle Dealer for service.



DANGER: If any problems are found, DO NOT operate vehicle until repairs are made. Failure to make necessary repairs could result in fire, severe personal injury, property damage or death. Consult your local Columbia ParCar Dealer for professional service.

Lifting Instructions



WARNING: Use extreme caution lifting or working on or around lifted vehicle. Vehicle should be lifted only when on a flat, hard and level surface.

When lifting the vehicle for service, use a sturdy lifting device such as a hoist, floor jack or hydraulic lift. ALWAYS block wheels and set parking brake of the vehicle to keep it from rolling. When using a lifting device, lift only on sturdy underbody parts, an example being the frame. When using a floor jack, lift only on sturdy underbody parts, an example being the frame or axle housing. After the vehicle is lifted to a 10° to 25° angle, place jack stands under vehicle rear unibody to support vehicle weight for added safety. Refer to figure 5.

Note: Be careful and watch for cables, linkages or wire harness.



CAUTION: Jack stands should be of sufficient rated weight capacity to hold the vehicle safely. See general vehicle specifications for empty weights.



CAUTION: If any vehicle is raised while loaded, check that the load is secured before lifting vehicle. Failure to do so could cause damage to vehicle, load or cause personal injury.

Hoist lifts:



CAUTION: Before lifting ALWAYS block wheels and set parking brake.

If a hoist lift is used to lift the vehicle, check that the hoist is rated at a lifting capacity greater than the vehicle weight. Lift the vehicle sufficiently from the floor, to a 10° to 25° angle, to allow the placement of jack stands and to support the weight of the vehicle during service.

To lift the rear, connect the lifting eyes/hooks to the rear frame at the right and left sides. DO NOT use the bumper as a lifting point. Place jack stands under the unibody at the right and left sides to allow for working on the vehicle. Then lower vehicle to proceed working on the vehicle. When work is completed again lift and then remove jack stands and lower vehicle to the floor.

To lift the front, connect the lifting eyes/hooks to the front undercarriage, by leaf springs. DO NOT use the leaf springs or front housing to lift the vehicle. Place jack stands under the unibody at the right and left sides. Then lower vehicle to allow working on the vehicle. When work is completed again lift and then remove jack stands and lower vehicle to the floor.

Floor jack:



CAUTION: Before lifting ALWAYS wedge wheels and set parking brake.

If a floor jack is used to lift the vehicle, check that the hoist is rated at a lifting capacity greater than the vehicle weight. Lift the vehicle sufficiently from the floor; to a 10° to 25° angle, to allow the placement of jack stands to hold the weight of the vehicle during service.

To lift the rear, place the floor jack under the rear axle housing and lift vehicle until jack stands can be placed under the rear unibody at the right and left sides to allow working on the vehicle. Lower vehicle onto stands and remove floor jack. When work is completed reuse floor jack, lift and then remove jack stands and lower vehicle to the floor.

To lift the front, place the floor jack under axle beam and lift. Place jack stands under the frame at the right and left sides to allow working on the vehicle. Lower vehicle onto stands and remove floor jack. When work is completed reuse floor jack, lift and then remove jack stands and lower vehicle to the floor.

Hydraulic floor lift – Frame lift:

Position vehicle over lift. Place lift arms under the frame of the vehicle and lift to service the vehicle.

Jack stands:

Jack stands need to be of sufficient load capacity to hold the full listed weight capacity, from the vehicle description and specifications section.

⚠ WARNING: DO NOT work under your vehicle unless it is firmly secured on jack stands.

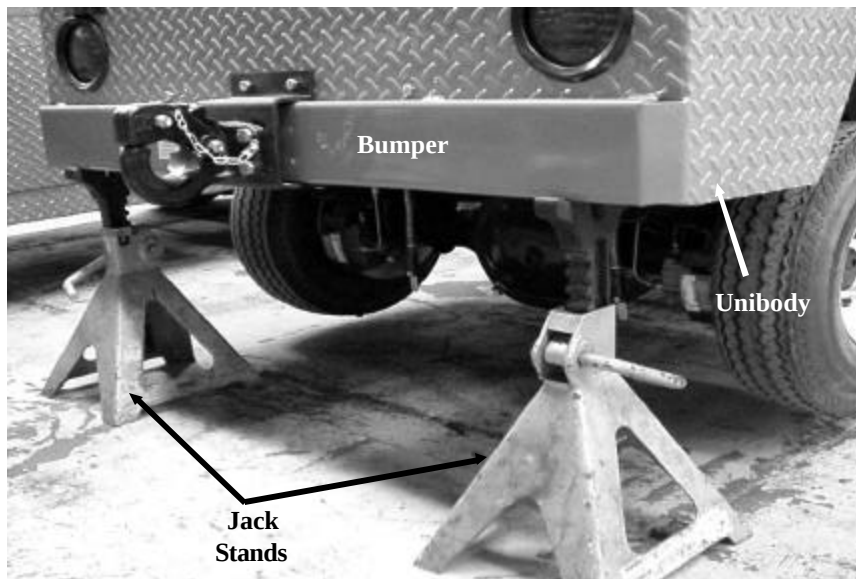


Figure 6 – Jack stands under vehicle

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Operator Safety Instructions

NOTE: It is the responsibility of the owner of this vehicle to assure that the operator understands the various controls and operating characteristics of this vehicle, as well as obeying the following safety rules and guidelines (extracted from the American National Standards Institute personnel and burden carriers ANSI B56.8).



WARNING: This vehicle is not designed to be driven on public highways. The Burden Carrier travels on level surfaces at a maximum rated speed of 8.5 mph. **DO NOT** exceed this speed. Exceeding this speed may result in steering difficulty, motor damage, and/or loss of control.

Safety Rules & Guidelines:

This vehicle is designed to be driven over smooth surfaces in and around places such as warehouses, factories, industrial sites, motels, parks, and resorts. Before you drive this vehicle, please observe the following safety rules and guidelines.

- Do not drive this vehicle unless you are a qualified and trained operator.
- Keep all body parts (head, arms and legs) inside this vehicle while it is moving.
- This vehicle may overturn, if turned sharply when driven at high speeds, especially when on an incline.
- Keep the vehicle under control at all times.
- No horseplay or dangerous driving.
- Do not drive this vehicle in hazardous areas unless this vehicle is approved and labeled for such operation.
- Immediately report any accident or vehicle problem to your supervisor.

Driver Training Program:

The owner of this vehicle shall conduct an Operator Training program for all those who will be operating this vehicle. The training program shall be in accordance with O.S.H.A.'s 29 CFR 1910.178 Powered Industrial Truck Training (PITOT) standard. Successful completion of the Operator training program shall be required for all personnel who operate this vehicle.

The Operator Training program shall include the following:

- Operation of this vehicle under circumstances normally associated with your particular environment.
- Emphasis on the safety of cargo and personnel.
- All safety rules contained within this manual.
- Proper operation of all vehicle controls.
- A vehicle operation and driving test.
- Re-evaluation on the above criteria and retraining at least once every three (3) years.

Safety Instructions (cont.)

Driver Qualifications:

Only those who have successfully completed the Operator training program are authorized to drive this vehicle. Operators must possess the visual, auditory, physical, and mental ability to safely operate this vehicle as specified In the American National Standards Institute Controlled Personnel and Burden Carriers ANSI B56.8.

The following are minimum requirements necessary to qualify as an operator of this vehicle:

- Demonstrate a working knowledge of each control.
- Understand all safety rules and guidelines as presented in this manual.
- Know how to properly load and unload cargo.
- Know how to properly park this vehicle.
- Recognize an improperly maintained vehicle.
- Demonstrate ability to handle this vehicle in all conditions.

Safety Committee

If the Industrial Vehicles are to be operated by renters or company employees, we recommend that a safety committee be appointed. The primary concern of this committee should be the safe operation of the vehicles.

Subjects which must be considered, include, but are not limited to, the following:

- Define where the vehicles should be driven and utilized.
- Ensure all proper warnings as to driving hazards are properly displayed and visible.
- Safety signage concerning hills, ramps, turns, blind crossings, intersections, etc is highly recommended.
- Define who should and who should not drive the vehicles
- Enforcement of safe driving and operating rules.
- Provide driver training for first time operators and review safe operating recommendations regularly.
- Maintain vehicles in a safe operating condition, maintain a schedule for daily, weekly, monthly, quarterly, semi-annually and annual vehicle inspections.
- Who, when and how should pre-operation inspections be conducted.
- What to do should an unsafe condition or operating problem be discovered.

These basic rules of operation, combined with courtesy and common sense, will help make driving your Columbia Industrial vehicle a safe and pleasant experience. The safety committee should be made up of managers and/or supervisors in charge or responsible for the operation and maintenance of the vehicles.

Vehicle Operating Controls

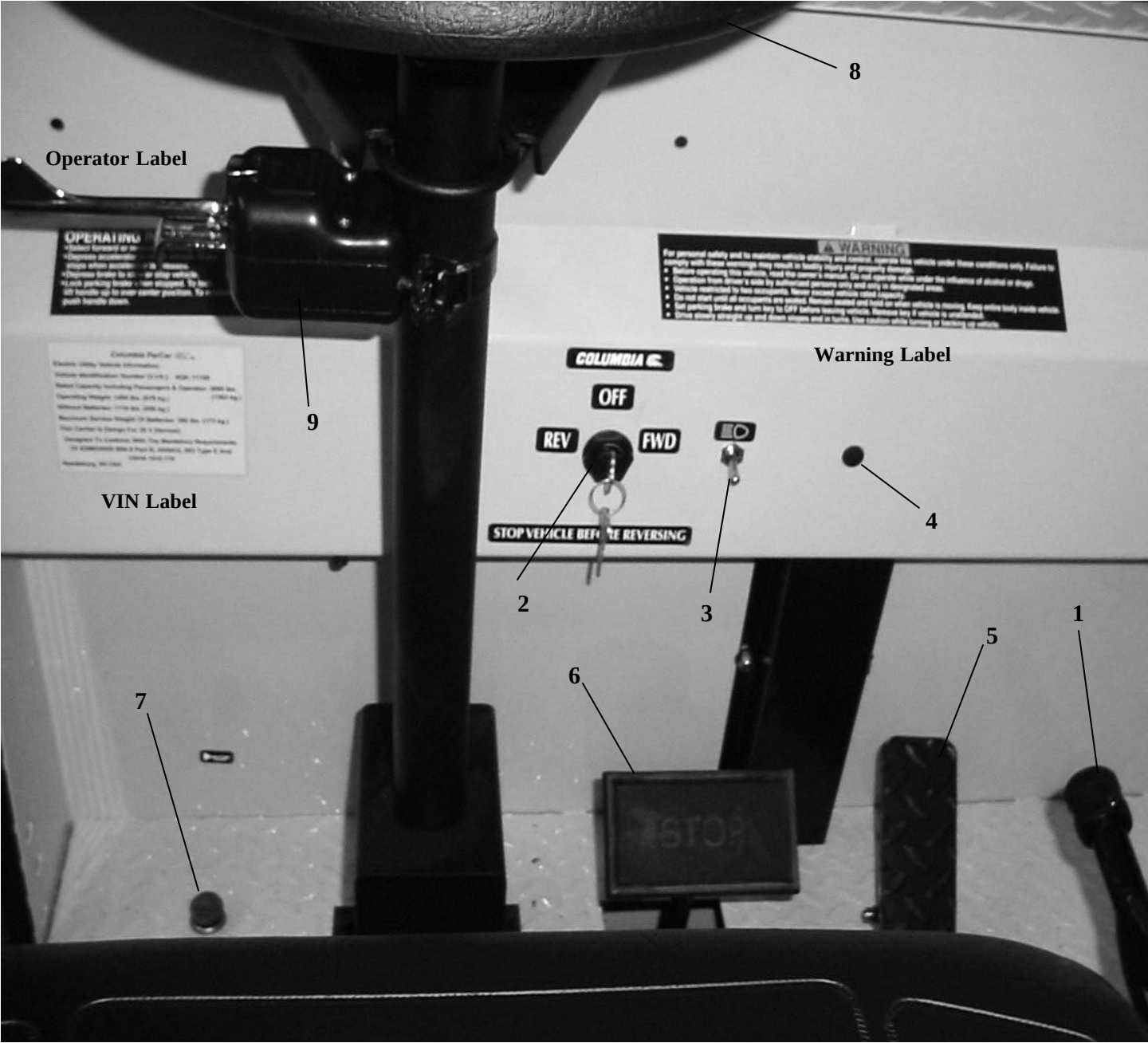


Figure 1 – Operating Controls

Vehicle Operating Controls (cont.)

1 - Parking Brake:

All Burden Carrier models are equipped with a parking brake lever located on the kickpanel between the driver and the passenger seats. To operate, pull up and back to engage; push forward and down to disengage.



CAUTION: Parking brake must be engaged whenever vehicle is left unattended.

2 – Key Switch:

The key switch is located dash panel. When the key switch is in the vertical position, the vehicle's speed control system is turned OFF. Turn key to the right from vertical to move the vehicle in forward. Turn key to the left from vertical to move the vehicle in reverse. Always take the key out of the switch when leaving the vehicle.

3 – Light Switch:

The light switch is a two-position toggle switch located on the dash panel to the right of the key switch. Move switch up to activate headlight and taillights, down to turn off.

4 - Wiper Switch: (Optional with cabs, not shown)

The wiper switch is a two-position toggle switch located on the dash panel located to the right of the light switch. Move switch up to operate windshield wiper, down to turn off.

5 – Accelerator Pedal:

The pedal controls the speed of the vehicle in the same manner as a conventional automobile.



CAUTION: Speed in reverse should ALWAYS be kept at a minimum

6 – Brake Pedal:

To operate service brakes, depress pedal. Depressing pedal also activates brakelights.

7 – Horn Button

The horn button is located floor to the left of the steering wheel. Press button to sound the horn.

8 – Steering Wheel

The steering wheel controls the path of the vehicle exactly the same as a conventional automobile wheel.

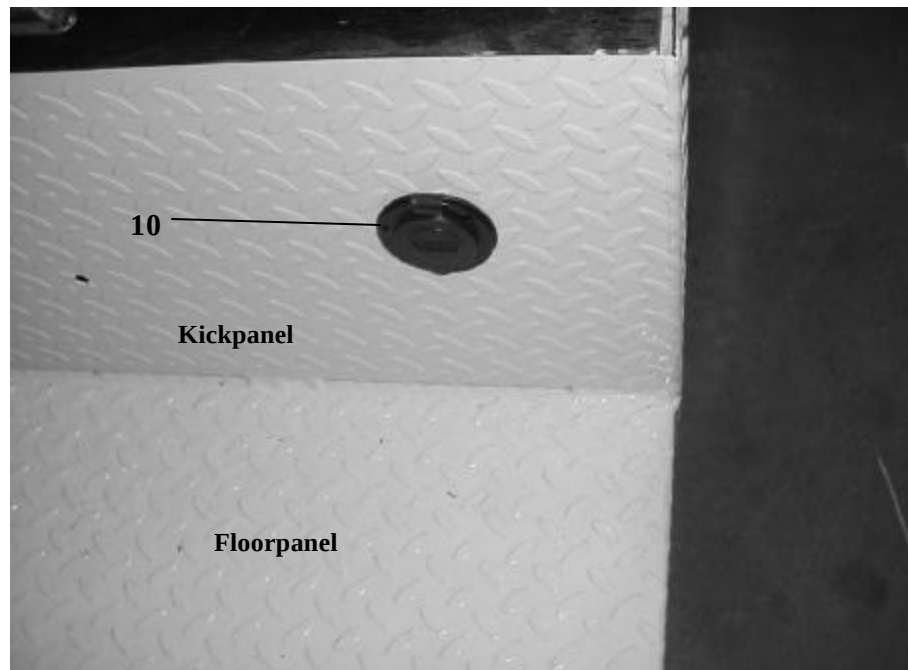
9 – Turn signal / Hazard Warning Switch:

The turn signal/hazard warning switch is located on the steering column below the steering wheel. When lever is moved upward right turn signal turns on and upper green light flashes. When lever is moved downward left turn signal turns on and lower green light flashes. To turn off the a signal move indicator lever back to center position. To operate the hazard warning lights pull outward on hazard bar. Moving the signal indicator lever to either turn signal position turns off the hazard lights.

Vehicle Operating Controls (cont.)

10 – Charger Receptacle:

The charger receptacle is located on the kickpanel by the drivers left leg. The AC cord is plugged in here for battery charging.



CAUTION: DO NOT attempt to recharge batteries with a charger not designed for your vehicle.

NOTE: If a portable charger is provided the receptacle is located on the dash panel. The DC cord is plugged in there for battery charging.

Battery Discharge Indicator and Hour Meter Indicators :

The Battery Discharge Indicator (BDI) is located on the support panel in front of the steering wheel column. The BDI indicates the batteries “state of charge” and is to the right of the Hour Meter. This item may not be included on all vehicles.

The Hour Meter is also located on the support panel in front of the steering wheel column. It indicates the total number of hours the vehicle has been operating. This item may not be included on all vehicles.

Vehicle Operating Instructions

⚠ CAUTION: Before operating the vehicle always check the following items. Should any item malfunction or need adjustment DO NOT operate vehicle until the problem has been corrected.

Table 1 - Pre-Operation Checklist	
Item	Procedure
Batteries	Check to assure they are fully charged or adequately charged to provide sufficient energy for duration of operations.
	Assure the AC cord is disconnected from the vehicle.
	Check to assure the electrolyte level in each cell covers the top of cell plates.
	Check that batteries are free of corrosion.
	Check for loose terminals or connections.
Tire Pressure	Check for proper inflation; keep tires inflated to the specifications labeled on the sidewall. Tire size 5.70 x 8, Factory setting is 35 to 50 psi.
Lights & Horn	Turn lights on and make sure they illuminate.
	Depress horn button to sound horn.
Brakes	Check brake pedal for a firm pedal pressure with minimal travel
	Check parking brake for proper engagement and release.
Steering	Check for steering responsiveness and the absence of excessive free play
Cargo	Check to make sure cargo is secured to the bed platform
	Check to make sure load is balanced and not top heavy
Obstacles	Check path of intended travel for obstructions and that underside is clear.
Seat Belts (If Equipped)	Make sure driver and passenger are secured by seatbelt before moving vehicle.

⚠ CAUTION: DO NOT overload the vehicle. Never exceed Maximum payload as specified on the vehicle data plate.

⚠ CAUTION: Your safety and the safety of others depend on your safe operation and maintenance of this vehicle. Prior to operation, you, the operator, must be thoroughly familiar with this and all other sections of this manual.

Operational Safeguards :

- Study controls and be familiar with their function before operating vehicle.
- Allow only authorized and trained personnel to operate vehicle.
- Remain seated with seat belts fastened (if so equipped) when vehicle is in operation
- Allow only one occupant per seat. DO NOT carry any other persons on the vehicle, unless vehicle is designed and equipped for such purpose.
- Keep arms, legs and feet inside vehicle at all times when vehicle is moving.
- Keep a clear view of the path of travel. Observe general traffic laws and maintain a safe clearance.
- Signal turns and stops far in advance of intended action.
- Keep vehicle clear of hazardous or explosive locations.
- Drive slowly when making turns.
- Drive slowly and straight on up and down slopes.
- DO NOT make turns on steep hills or inclines.
- Maintain a safe distance from the edge of ramps and platforms.

Vehicle Operating Instructions (cont.)

- Set parking brake before leaving vehicle and also remove key when vehicle is unattended.
- Block wheels of vehicle if left on an incline.

Driving The Vehicle :

- Fasten seat belts (if vehicle is so equipped).
- Insert key in switch, depress brake pedal firmly, and turn key to "ON" position.
- Switch electric shift switch to the direction of desired travel.
- Release the parking brake and brake pedal.
- Slowly depress accelerator pedal to obtain desired vehicle speed.
- To slow or stop vehicle, remove foot from accelerator and depress brake pedal.

NOTE: Never rest your foot on brake pedal while operating the vehicle. This wears brake pads, creates drag and causes excess battery discharge.

- When parking the vehicle, move switch to the "Neutral" position, engage parking brake, turn key to "OFF" and remove.



CAUTION: Never leave the vehicle until you are fully stopped. Set the parking brake, positioned the direction switch to "Neutral," turned the key switch to "Off" and remove the key if vehicle is left unattended.



CAUTION: When parking headed downhill, turn the front wheel(s) into the curb or toward the side of the road and engage parking brake.



CAUTION: When parking headed uphill, turn the front wheel(s) away from the curb and let the vehicle roll back a few inches until the rear of one front wheel gently touches the curb and engage parking brake.

Vehicle Storage

Storage:

If stored for a prolonged period, the batteries should be charged as follows:

Table 2 - Battery storage charging times	
Storage Temperature	Charge at
Below 40 ⁰ F	Every 6 months
40 ⁰ – 60 ⁰ F	Every 2 months
Above 60 ⁰ F	Once a month

NOTE: Batteries "self-discharge" when not in use. The specific gravity of the electrolyte should be checked every 6 to 8 weeks using a hydrometer. See chapter 3 for further details. The batteries should be recharged as necessary to resume specific gravity to fully recharged levels-approximately 1.260. Fully charged batteries should be stored in a cool environment.

Vehicle Storage (cont.)



WARNING: Turn keyswitch “OFF” and remove key during storage to prevent unintentional starting of vehicle.



WARNING: DO NOT attempt to charge a battery that is frozen or if battery case is excessively bulged. Properly dispose of battery, because frozen batteries can explode.

If battery terminals or wires are damaged or corroded, they should be cleaned or replaced as necessary. Failure to do so may cause them to overheat during operation.



Caution: Batteries in a low state of charge will freeze at higher temperatures than fully charged batteries.

Preparing vehicle for extended storage:

Electric vehicles stored over six (6) to eight (8) weeks must be protected to maintain battery life. Several guidelines should be observed when storing your electric vehicle.

1. Fully charge batteries. With electrolyte full in all cells, store batteries in a cool place. If stored above 50 degrees F (27° C), check State of charge every four (4) to six (6) weeks and charge as necessary to maintain 1.250 to 1.270 specific gravity. If vehicles are stored in temperatures below 40° F check state of charge every fifteen (15) to eighteen (18) weeks. Use figure 4 to determine freezing point of batteries and maximum recommended storage temperature. Refer to Appendix C for charging procedure.
2. Wash off any corrosion around the terminals with a solution of baking soda and water. DO NOT allow this solution to enter batteries.
3. Store vehicle in a cool dry place to prevent battery discharge.
4. For proper tire inflation refer to manufacture’s recommendation imprinted on tire sidewall. Factory tire pressure set at 35 to 50 psi for 5.70 x 8 tires.
5. Grease suspension and continue quarterly lubrication during storage period.
6. Clean vehicle body, seats, battery compartment and vehicle underside.
7. DO NOT engage park brake. Block wheels to prevent movement.

Returning vehicle to service:

1. Fully recharge batteries.
2. Check tire pressure and keep tires inflated to the specifications labeled on the sidewall. Readjust if necessary.
3. Perform initial maintenance per Service and Maintenance Schedule Chapter 3.

Specific Gravity and Freeze Point										
Specific Gravity	1.260		1.230		1.200		1.117		1.110	
Freezing Point of Electrolyte	F -70	C -57	F -39	C -38	F -16	C -26	F -2	C -19	F +17	C -8

Figure 4 – Freezing point of batteries

Chapter 3

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MAINTENANCE GUIDELINES

To ensure that the Burden Carrier is kept in a safe and correct operating condition, the vehicle must be inspected and maintained on a regular basis. Proper lubrication, electrical control adjustments, safety feature inspections, etc. must be performed at recommended intervals to prevent damage or failure, while providing optimum performance.



WARNING: No modifications or additions, which affect the mechanical or electrical integrity and the safe operation of the unit, shall be made without the written approval of the manufacturer. If such modifications are approved, the capacity, operation, and maintenance instruction markings shall be changed accordingly. In no case shall the safety factors be reduced below those specified in this manual or the manufacturers design factors, whichever is greater.

This section explains how to perform maintenance procedures and use the maintenance checklist to determine how often you should perform each procedure. Follow the guidelines below to assure proper maintenance of your Burden Carrier.

- Allow only trained maintenance personnel to maintain, repair, and inspect the vehicle.
- Before starting any repairs or maintenance, immobilize the vehicle by turning the key switch off, removing the key and setting the park brake.
- Disconnect both of the main battery leads before working on or disconnecting any electrical component or wire.
- Support the chassis with jack stands before working under a raised vehicle.
- Conduct vehicle performance checks in an authorized area where a safe clearance exists.
- Before starting the vehicle, follow the recommended safety procedures in Chapter 2, (Operator Information).
- Avoid fire hazards and have fire protection equipment present in the work area.
- DO NOT use an open flame to check level or leakage of battery electrolyte.
- DO NOT use open fuel or flammable fluids for cleaning parts.
- Work in a properly ventilated work area.
- Regularly inspect and maintain in safe working condition the brakes, steering mechanisms, speed and directional control mechanisms, warning devices, guards and safety devices.
- Inspect and maintain battery limit switches, protective devices, electrical conductors and connections in conformance with the manufacturer's recommended procedures.
- Keep the vehicle in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

CHECKLIST

A good planned maintenance program is important for the safe, reliable operation of all Columbia Industrial & Commercial Vehicles. The recommended procedures described in this service manual are effective methods for performing periodic maintenance and repair.

Note: Some procedures require the use of special tools. These special tools should be used when and where recommended.

Note: When performing Monthly, Quarterly, Semi-Annual or Annual maintenance, insure that Daily and Weekly Inspections are included.

CHECKLIST (cont.)

Note: The environment that your vehicle operates in can vary widely. Severe conditions or duty cycles will require the periodic maintenance recommendations to be adjusted to more frequent time intervals. Examples of severe service operations include (but are not limited to) the following:

1. Dusty or sandy locations such as cement plants, lumber or flourmills, coal dust or stone-crushing areas.
2. High Temperature Areas such as steel mills, foundries, etc.
3. Sudden temperature changes such as continuous indoor-outdoor movement, as in refrigeration plants, etc.

Periodic Service Calendar		
JANUARY Monthly	FEBRUARY Monthly	MARCH Quarterly
APRIL Monthly	MAY Monthly	JUNE Semi-Annual
JULY Monthly	AUGUST Monthly	SEPTEMBER Monthly
OCTOBER Monthly	NOVEMBER Monthly	DECEMBER Annual

Note: Daily maintenance is performed daily before operation of the vehicle by the owner or operator. Weekly maintenance should be performed on a weekly basis to include all daily maintenance and should be performed by the owner, operator or trained maintenance personnel.

Service & Maintenance Schedule						
Item	Operation *	Weekly	Monthly	Quarterly	Semi-Annual	Annual
Batteries	Clean terminals and wash battery case	Page 3-10				
	Check electrolyte level	Page 3-10				
	Spot check battery specific gravity	Page 3-8				
	Inspect batteries for corrosion, loose connections & broken or frayed cables	Page 3-10				
Tires	Tie Rods/Linkage - Check for excessive movement, tightness of hardware	Test Drive				

Service & Maintenance Schedule						
Item	Operation *	Weekly	Monthly	Quarterly	Semi-Annual	Annual
	For proper tire inflation refer to manufacture's recommendation imprinted on tire sidewall. (Initial factory tire pressure is 35 – 50 psi for 5.70 x 8 Setting), NOT to exceed tire sidewall rated capacity of 75 psi at full load	Page 3-17				
Electrical System	Electrical wires - Check for tightness or damage	Visual				
	Grounding wires - Check for tightness or damage	Visual				
	Inspect motor brushes & brush springs, replace if necessary			Page 3-7		
	Check the general condition of the electrical system (loose connections, frayed or broken cables, shorts, etc.)			Visual		
Brakes	Check brake fluid level (hydraulic brakes)			Visual		
	Parking adjustment			Page 3-13		
	Check brake pads- Replace if necessary				Page 3-14	
Drive	Check drive chain/belt tension			Pages 3-12/3-13		
Body and Frame	Inspect for loose hardware (bolts & nuts, etc.)	Visual				
	Clean Body and Seats, wash as needed		Page 3-17			
	Wash engine compartment and undercarriage			Page 3-17		
Lube	Wheel bearings. Grease or replace if Necessary					Page 3-18
	Steering Gear Grease					Page 3-18
	Pivot points with grease fittings				Page 3-18	
	Pivot points without grease fittings			Page 3-18		
	Check differential Fluid (Always check upon receipt of vehicle)				Page 3-18	
* Refer to individual maintenance sections of this manual for details of Service / Maintenance Operations.						

Before operating the vehicle inspect vehicle for damage, check operating controls (including Reverse Warning Alarm), check tires for proper inflation and test drive.

TROUBLESHOOTING HINTS



CAUTION: To prevent possible injury, always disconnect batteries and remove key before working on vehicle

Troubleshooting Hints Chart		
Problem	Possible Cause	Remedy *
Vehicle will not run	Key Switch	Check for loose wires or faulty switch.
	Batteries	Check for loose terminals or corrosion. Check distilled water level. Check battery state of charge.
	Motor	Check for loose wires, open circuits or worn brushes
	Speed Control	See troubleshooting guide in appendix F.
Vehicle runs slow	Batteries	Check for loose terminals or corrosion. Check distilled water level. Check battery state of charge.
	Brakes	Check for dragging brakes.
	Tires	Check for under inflated or flat tires.
	Wheels	Check to see that wheels are not binding and spin freely.
* If these test procedures do not resolve your vehicle problem, contact your authorized Columbia Industrial & Commercial Vehicle Dealer		

The Service and Maintenance section that follows contains the most current information available at the time of publication. The Service / Maintenance operations outlined in this manual are intended only as a guide and highlight major points only. It is not intended as a Shop Manual. If you need more information regarding a specific item or encounter problems contact your local Columbia Industrial & Commercial Vehicle Dealer or Columbia ParCar Corp. Technical Services.

GENERAL SAFETY PRECAUTIONS



CAUTION: To prevent possible injury, always disconnect batteries before performing any maintenance; see "Safety Precautions" for disconnect method.



CAUTION: To prevent the possibility of a runaway vehicle and/or damaged components after work is performed on the drive train, speed control or electrical system in general:

- 1) Raise both rear wheels off the ground and block the front wheels. Place jack stands as needed.
- 2) Reconnect battery pack, positive cable first.
- 3) Test vehicle function(s) before lowering vehicle to the ground and attempting vehicle operation.



CAUTION: When replacing any part or fastener, use only Columbia Industrial Vehicle replacement parts, or parts that are equivalent in terms of rated strength, capacity, material, etc. and that are certified for the purpose intended. Failure to do so could cause vehicle malfunction and possible personal injury. A convenient chart summarizing the frequency of service requirements and the type of maintenance required is included on page 4 (Service / Maintenance Schedule). To perform many of the maintenance items listed, as well as many of the service and general repair jobs detailed in the following pages, it will be necessary to remove either one or both of the deckboards.

Handlifts have been incorporated into the deckboards to ease the removal operation. To prevent possible injury, care should be exercised while removing deckboard (s).

Maintenance Procedures

ELECTRICAL SYSTEMS

MOTOR BRUSHES

See chapter 4 for exploded view and parts list. Check the motor brushes every 3 months for wear and spring tension. Visually inspect brushes for cracks, chips or wear to a length of 3/4" or less. Whenever brushes are replaced, replace the entire set. Check each brush for free movement in its holder. Replace any weak brush springs. Extensive motor repair work, if needed, should be handled through your local Columbia Industrial & Commercial Vehicle dealer or Columbia ParCar Corp. Technical Services.



CAUTION: The motor is heavy! Use correct lifting procedures to avoid back injury.



Chain Cover

Figure 1 - Motor

MOTOR REMOVAL

- 1) Disconnect all wires from the motor. Label the leads for easy identification when replacing the motor.
- 2) Remove chain cover.
- 3) Support the motor using a sling or strap.
- 4) Loosen the motor mounting bolts, inside chain cover.
- 5) Rotate CCW adjuster cam allowing the motor to move downward, relieving tension on chain.
- 6) The chain may now be removed by lifting it off of the sprockets.
- 7) Remove the motor mounting bolts and lift the motor out of vehicle.

BATTERIES

Battery Care

Electric Vehicle Battery

The storage battery receives, stores, and delivers electrical power. This receiving, storing, and delivering of electrical power is called a cycle.

- Receive - Charging vehicle batteries.
- Store - Vehicle standing idle.
- Deliver - Driving vehicle.

The type of battery used in a Columbia Industrial & Commercial Vehicle has a service requirement, which is quite different from that of an automotive battery.

BATTERIES (cont.)

The electric vehicle battery supplies all of the power to drive the vehicle, and during operation the "power" stored in the batteries is expended. While the amperage drain rate can vary greatly depending on the type of service, the duration of use and the number of "starts" and "stops" made during a day, the batteries nevertheless progress through each duty cycle from "fully charged" to an almost depleted state. This type of service is known as "deep cycle" service and electric vehicle batteries are specifically designed to handle this type of service. Proper performance of your Columbia Industrial Vehicle can only be obtained from specified deep cycle, electric vehicle batteries.



CAUTION: Automotive batteries should never be used for "deep cycle" application, as their useful life will be very short.



CAUTION: Use extreme caution when working on or near batteries. Gases escaping from charging batteries are extremely explosive and battery electrolyte is a strong acid. See "Proper Care and Maintenance of Electric Vehicle Industrial Batteries," described in this section.



WARNING: Batteries contain sulfuric acid, which is highly corrosive and can cause chemical burns. Avoid contact with skin, eyes or clothing. Always wear approved eye protection when working around batteries.

Antidote:

- External- Flush with water.
- Internal - Drink large quantities of milk or water, followed by Milk of Magnesia, vegetable oil or beaten eggs. CALL DOCTOR IMMEDIATELY.
- Eyes - Flush with water, get immediate medical attention.

Battery Testing

Specific Gravity Test:

It is possible to estimate a battery's ability to perform by measuring the specific gravity of each cell with a hydrometer. The hydrometer readings indicate two things:

- a. State of Charge- the amount of electrical power stored in the battery.
- b. Condition- The ability of battery to store and deliver power.

Note: Always fully charge batteries before performing specific gravity tests to determine battery condition.

State of Charge	Specific Gravity (80° F)
100%	1.250-1.270
75%	1.220-1.240
50%	1.190-1.210
25%	1.160-1.180
Specific Gravity Taken from at Least 2 Cells of Each Battery	

Using the Hydrometer:

1. Squeeze rubber bulb and insert nozzle into cell, release bulb, slowly drawing electrolyte up into barrel.
2. Adjust electrolyte level in barrel so float rises free of bottom but is not striking top of barrel.

BATTERY TESTING (cont.)

3. Hold hydrometer vertically, making sure float moves freely and is not contacting sides of barrel. Read electrolyte level in relation to the scale printed on the float.
4. Record the reading.
5. Return electrolyte to cell from which it was removed.
6. Repeat these steps on all battery cells.

Note: ALWAYS rinse the hydrometer in “Fresh” clean water after use.

The temperature of the electrolyte being tested affects hydrometer readings. Measure the temperature of the electrolyte and correct your readings as follows:

Above 80° F - Add .004 to the specific gravity readings for each 10° above 80° F.

Below 80° F - Subtract .004 from the specific gravity readings for each 10° below 80° F.

Interpretation of Hydrometer Readings:

State of charge: Check specific gravity of each cell. Refer to tables below:

State of Charge	Specific Gravity (80° F)
100%	1.250-1.270
75%	1.220-1.240
50%	1.190-1.210
25%	1.160-1.180

Condition: If the difference between the highest and lowest cell is .050 (50 points) or more, the battery is nearing the end of its useful life. The batteries should be replaced as a set.

Note: If the highest cell reads less than 1.200, the test for condition is questionable. Recharge battery and perform test again.

Inspection and Maintenance:

- New batteries should be given a full charge before their first use because it is difficult to know how long the batteries have been in storage without a charge.
- Limit use of new batteries between charges for the first 5 cycles. New batteries and older batteries, which have been in storage, are not capable of their rated output until they have been discharged and charged a number of times.
- During the first month of use, particularly when temperatures are below 60°F, new batteries should be given an extra full charge once a week. The ampere -hours of energy those batteries can deliver and the rate at which they charge varies directly with battery temperature. Lower temperatures will require lower charge cycles.
- The charge rate will taper down to the specified finish charge rate near the end of the charge cycle, and then will shut off automatically. All cells in a set of batteries do not react identically to the same discharge and charge current. In a normal charge, the last 1 to 3 hours at the low finish charge rate equalizes these cells for better battery life.
- When batteries age to the point where the charge rate will no longer taper into the low finish rate, the batteries should be tested to see if they are nearing the end of their useful life.

BATTERIES (cont.)

- Add distilled water carefully to the proper level in cells as required only after they have been fully charged. Do not fill them so high that they bubble over while charging. New batteries require very little addition of distilled water, whereas very old batteries may require additional distilled water two or three times a week. Water (electrolyte) levels drop as batteries are discharged and rise during charge. Adding water when batteries are fully charged will reduce the probability of overfilling. See Figure 2.

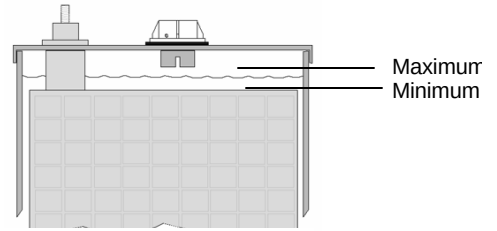


Figure 2 - Electrolyte

- When the temperature falls below 65°F, batteries should be placed on charge as soon after use as possible. In these low temperatures an additional equalizing charge once a week will improve the state of charge and battery life.
- Be sure battery hold-downs are properly tightened. A loose hold down may allow the battery to become damaged from vibration or jarring. A hold down that is too tight may buckle or crack the battery case.
- Batteries must be clean and dry. Dirt and electrolyte on top of batteries will cause batteries to self-discharge. Clean battery tops with a baking soda (sodium bicarbonate) and water solution (5 teaspoons baking soda per quart water). Do not allow solution to enter cap vent holes.
- Check to see that battery cap vent holes are clear. Plugged vent holes will not permit gas to escape from the cell and could result in battery damage.
- Inspect battery posts, clamps and cables for breakage, loose connections and corrosion. Remove cables to clean battery posts and clamps when signs of corrosion appear.
- Inspect battery case for cracks or leaks.

Battery Removal:

1. Remove battery negative (-) cables.
2. Remove battery positive (+) cables.
3. Remove battery hold down.
4. Remove batteries from vehicle.



WARNING: Use care not to drop batteries because the case may crack spilling battery acid, causing severe burns.

NOTE: Negative battery posts face the vehicle rear and Positive posts face the vehicle front.

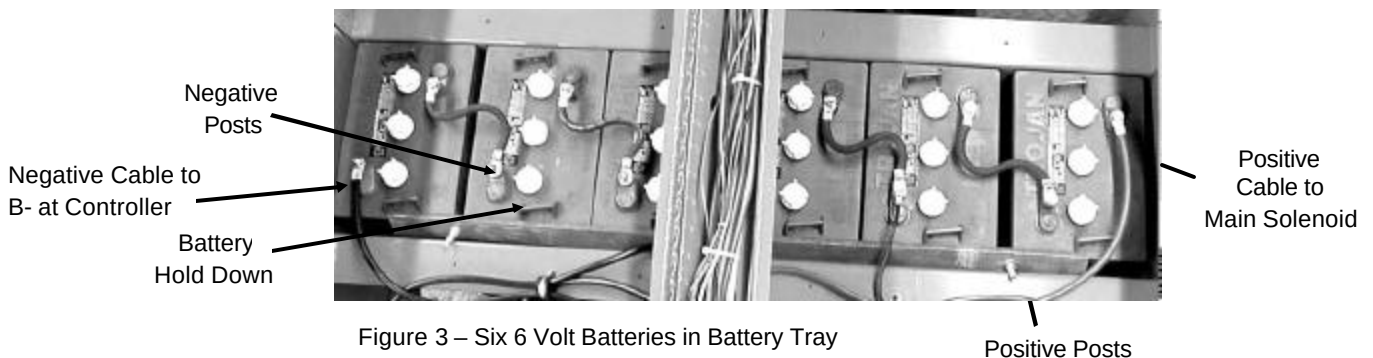


Figure 3 – Six 6 Volt Batteries in Battery Tray

BATTERIES (cont.)

Installation:

To install the batteries, reverse the removal procedure with the negative cable being attached last.

AUTOMATIC BATTERY CHARGER



CAUTION: When charging your Columbia Industrial & Commercial Vehicle, provide adequate ventilation during the charging cycle. Do not allow open flames or sparks near batteries during charging cycle. Hydrogen gas is generated during the charging process and can be explosive.

Automatic Battery Charger Operating Instructions:



CAUTION: Use this charger only on circuits provided with a maximum of 20 ampere branch circuit protection in accordance with the National Electrical Code, ANSI/NFPA 70, and all local codes and regulations. Improper AC supply circuit protection may result in a fire.



WARNING: Chargers can ignite flammable materials and vapors. Do not use near fuels, solvents, grain dust, or other flammables. Batteries generate gasses, which can be explosive. Keep sparks and open flame away from the batteries, No smoking!



WARNING: To reduce the risk of an electric shock, connect only to properly grounded outlets. Keep the charger dry. Do not expose it to rain. For storage, keep the charger in a building.

- 1) Connect the AC supply cord to a properly grounded three-wire outlet of the proper voltage and frequency as shown on the front of the charger. Charger will start automatically in 3 to 5 seconds.



CAUTION: Do not leave the charger on while unattended for more than two days in a row. Severe overcharging and damage to the batteries may result if the charger does not turn off.

- 2) Monitor the ammeter for the correct charge rate. The initial charge rate will vary from 14 to 22 amps depending on how much the batteries have been discharged. The charge rate will taper gradually to a finish rate of 6 to 12 amps if the batteries are in good condition. The charger will shut off automatically when the batteries are fully charged.
- 3) After the charger has turned off, disconnect the AC cord from the vehicle.

Charging Batteries Outside Vehicle for Units Equipped with Additional Battery Sets and Portable Charger:



CAUTION: Before proceeding with battery removal, check that key is off and removed from switch and all electrically operated accessories are turned off. Failure to do so may cause a spark as the battery pack is disconnected igniting potentially explosive battery gases.

When a vehicle contains optional rollout battery racks, a portable charger that is plugged into the batteries after they have been rolled out onto an appropriate battery transfer stand charges the batteries.

- 1) Be sure the battery stand is in place before starting to roll the battery rack out of the vehicle.
- 2) Pull the rack out far enough so the large disconnect plug swings into view.

BATTERIES & ELECTRICAL (cont.)

- 3) Continue to pull the battery rack onto the stand. The disconnect plug will automatically be pulled apart by the momentum of the rack.

⚠ Caution: DO NOT use anything to pry the two halves apart. The plug can be broken or a short can result from trying to pry the plug apart.

- 4) Plug the charger cords into the battery pack and the charger into an AC outlet at the designated charging station.

There may also be a separate manual which accompanied the charger when delivered with any portable charger you receive. Refer to the charger manual for additional information.

Lamps, Fuse and Flasher

REPLACEMENT CHART	
Item	Part No.
Lamps	
Headlight	69731-00
Taillight, Stoplight, Rear Turn Signal	69798-00
Kit, Front Turn Signal & Hazard Lights	68860-00
Front Turn Signal & Hazard Lights, Amber	68501-00
Fuses (Located Under The Seat Board)	
Main 12v / 30 Amp Neg.	69702-00
Auxiliary / 10 Amp Circuits	69717-00
Flasher	
Hazard & Turn Signal Flasher	71975-87

DRIVE SYSTEM

Drive Chain Adjustment

- 1) Remove chain cover.
- 2) Loosen the 4 motor mounting bolts slightly (see Figure 5)
- 3) Rotate adjuster cam counterclockwise until chain is correctly tensioned (see Figure 4). The chain should deflect 1/8" to 3/16" when pressed down at the middle of the span (see Figure 4).
- 4) Tighten motor mounting bolts and re-check chain tension.
- 5) Replace the chain cover, using a silicon sealant between the cover and backing plate (GE. RTV 012 equivalent). Replace approximately 3 to 5 lbs. of grease with 86T sprocket (Molufa - Alloy #0 or equivalent),
- 6) Thoroughly clean the area of the backing plate around the motor. Re-apply a bead of silicone sealant to the joint between the motor and the backing plate. Be sure to fill any newly exposed portions of the slotted motor mounting holes.

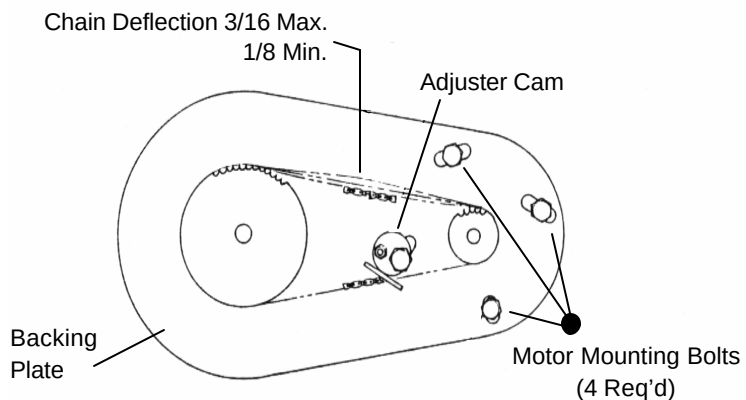


Figure 4 – Chain Tension

DRIVE SYSTEM (cont.)

Chain and/or Sprocket Replacement

- 1) Remove chain cover.
- 2) Loosen the 4 motor mounting bolts.
- 3) Rotate the adjuster cam allowing the motor to move downward, relieving tension on chain.
- 4) The chain may now be removed by lifting it off of the sprockets.
- 5) The lower sprocket may be replaced by removing the four sprocket mounting bolts.
- 6) The upper sprocket may be replaced by loosening the two setscrews in the sprocket hub and removing the sprocket from the motor shaft with a gear puller.
- 7) After the required parts have been replaced, follow steps 3 through 6 under "Drive Chain Adjustment."



Figure 5 - Motor and Backing Plate

DRIVE SYSTEM M-18

Drive Belt Adjustment

- 1) Remove belt cover.
- 2) Loosen the 4 motor mounting bolts slightly (see Figure 6)
- 3) Rotate adjuster cam counterclockwise until belt is correctly tensioned (see Figure 6). The belt should deflect 1/8" to 1/4" when pressed down at the middle of the span (see Figure 6).
- 4) Tighten motor mounting bolts 35 ft. lbs. and re-check belt tension.
- 5) Replace the belt cover.

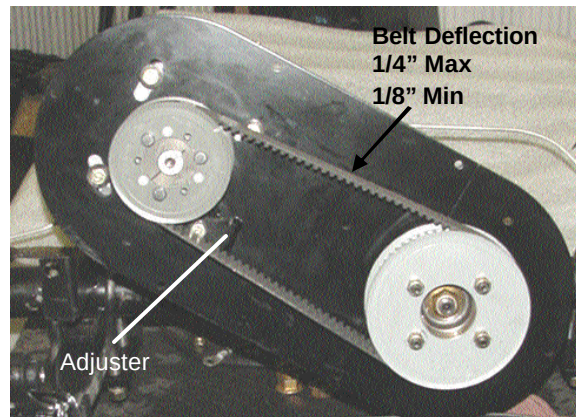


Figure 6 – Belt Tension

Belt and/or Sprocket Replacement

- 1) Remove belt cover.
- 2) Loosen the 4 motor mounting bolts.
- 3) Rotate the adjuster cam allowing the motor to move downward, relieving tension on belt.
- 4) The belt may now be removed by lifting it off of the sprockets.
- 5) Remove yoke nut lower drive sprocket
- 6) **Note:** Always replace yoke nut when reinstalling.
- 7) The lower sprocket may be replaced by removing the four sprocket mounting bolts.
- 8) The upper sprocket may be replaced by loosening all capscrews in the sprocket hub and thread capscrews into tapered holes in mating part to jack bushing flange.
- 9) Loosen setscrews to slide bushing.
- 10) To install make sure tapered surface of bushing and bore of mating part are clean.
- 11) Install shaft key.
- 12) Slide bushing on shaft, flange first, snug setscrew against screw.
- 13) **Note:** Excessive torque will cause mating part to eccentric.
- 14) Using a torque wrench, tighten capscrews evenly and progressively in rotation to 9 ft. lbs (100 in. lbs.)
- 15) After the required parts have been replaced, follow steps 3 through 6 under "Drive Belt Adjustment."

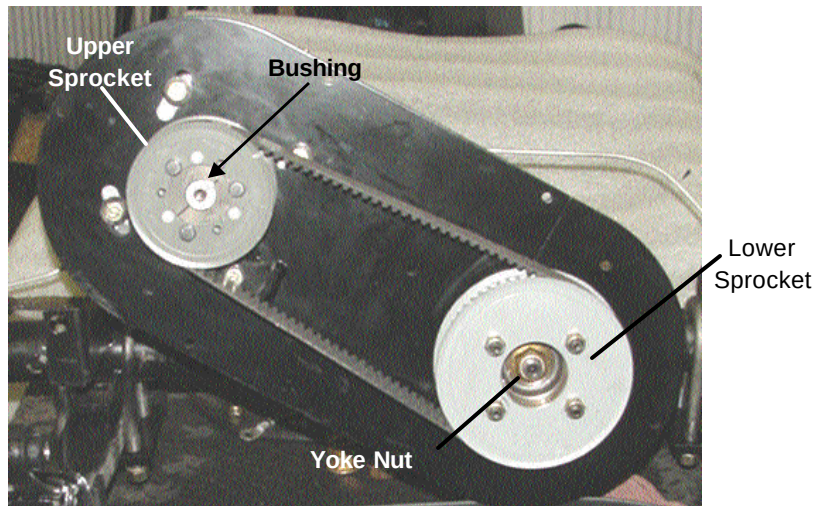


Figure 7 – Pulling Installation

BRAKE SYSTEM

Handbrake - Parkbrake Arm Adjustment

As the brake pads wear thinner, one MUST adjust the park brake (See Figure 8) to preserve proper hand brake operation. Be very cautious when performing this adjustment or doing any work on your brakes. Handbrake-Parkbrake adjustment is made to hold the vehicle, load capacity and driver on 15% grade for 15 minutes (ASME B56.8).

- 1) Loosen the lock screw on the hand-parkbrake knob
- 2) Rotate the knob clockwise to loosen brake or counter clockwise to tighten braking.



Figure 8 – Hand Parkbrake

BRAKE SYSTEM(cont.)

Disc Brakes

Most common complaint is noise when brakes are applied and vehicle is rolling slowly.

- Brake pads may require replacement.
- Brake disc may require resurfacing.

Adjustment — Disc Brakes

The disc brakes require no adjustment as they are self-aligning and self adjusting.

Pads should be checked for wear periodically and at least every six (6) months. Replace as necessary.

Disc Brake Pad — Replacement (See Chapter 4 Page 4-16 and 4-17 for exploded views).



CAUTION: Disconnect batteries and raise the end of the vehicle to be worked on off the ground and block the wheels on the opposite end of the vehicle.

- 1) Remove wheel and tire.
- 2) Remove parkbrake cable from park brake arm on the caliper.
- 3) Remove the two 5/16" bolts from the brake caliper mounting bracket.
- 4) Remove caliper assembly by sliding off rotor. Do not disconnect hydraulic line from caliper.
- 5) Slide the caliper carrier out from the caliper housing exposing the brake pads.
- 6) Remove brake pads from caliper dead side housing and from pistons. DO NOT remove pistons from caliper housing.
- 7) When replacing brake pads —push into housing.
- 8) Re-assemble by reversing steps 1 through 7, using new brake pads.
- 9) Use caution when remounting the brake calipers. Tighten each of the 5/16" bolts gradually alternating from one to the other. As you tighten the bolts be certain that the pads are parallel to the disk—if they are not, a "spongy" brake pedal may result. Also be sure that the caliper can still move back and forth in the caliper housing mounting—if it can't, uneven pad wear will result.
- 10) If rear brake pads are replaced — adjustment of park brake will be necessary. (See "Handbrake - Parkbrake Arm Adjustment.")
- 11) Reinstall wheel and tire. Tighten the lug nuts evenly in a star pattern until the nuts are all seated and torque to 50-60 ft. lbs.

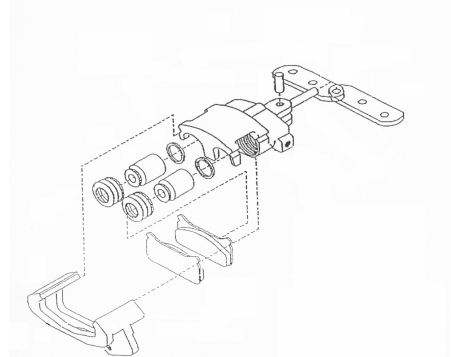


Figure 9 – Rear Brake Caliper Assembly

NOTE: Do not press on the brake pedal when the disc brake pads are not in place.

Rotor Replacement — Front Wheel



CAUTION: Disconnect batteries and block rear wheels and raise front of vehicle off the ground. See Chapter 1 for lifting instructions.

- 1) Remove wheel and tire.
- 2) Remove parkbrake cable from park brake arm on the caliper.
- 3) Remove the two 5/16" bolts from the brake caliper mounting bracket.
- 4) Remove caliper assembly by sliding off rotor. Do not disconnect hydraulic line from caliper.
- 5) The rotor may now be removed from the spindle by removing the dust cover, cotter pin and spindle nut.
- 6) At this point the rotor may be either resurfaced (See "Rotor Wear Limits") or replaced with a new rotor.
- 7) To replace rotor, reverse steps 1 through 5.

ROTOR REPLACEMENT (cont.)

- 8) Use caution when remounting the brake calipers. Tighten each of the 5/16" bolts gradually alternating from one to the other. As you tighten the bolts be certain that the pads are parallel to the disk—if they are not, a "spongy" brake pedal may result. Also be sure that the caliper can still move back and forth in the caliper housing mounting—if it can't, uneven pad wear will result.
- 9) Reinstall wheel and tire. Tighten the lug nuts evenly in a star pattern until the nuts are all seated and torque to 50-60 ft. lbs.

Rotor Replacement — Rear Wheel



CAUTION: Disconnect batteries and block front wheels and raise rear of vehicle off the ground. See chapter 1 for lifting instructions.

- 1) Remove wheel and tire.
- 2) Remove parkbrake cable from park brake arm on the caliper.
- 3) Remove the two 5/16" bolts from the brake caliper mounting bracket.
- 4) Remove caliper assembly by sliding off rotor. Do not disconnect hydraulic line from caliper.
- 5) Remove the four 3/8" lock nuts from the inside face of the axle-housing flange accessible through slots in the brake rotor.
- 6) The axle shaft may now be removed with a slide hammer puller.
- 7) Remove the four 5/16" bolts from the brake rotor mounting flange and remove rotor.
- 8) At this point the rotor may be either resurfaced (See "Rotor Wear Limits") or replaced with a new rotor.
- 9) Complete re-assembly by reversing steps 1 through 7.
- 10) Use caution when remounting the brake calipers. Tighten each of the 5/16" bolts gradually alternating from one to the other. As you tighten the bolts be certain that the pads are parallel to the disk — if they are not, a "spongy" brake pedal may result. Also be sure that the caliper can still move back and forth on the mounting pins — if it can't, uneven pad wear will result.
- 11) Reinstall wheel and tire. Tighten the lug nuts evenly in a star pattern until the nuts are all seated and torque to 50-60 ft. lbs.

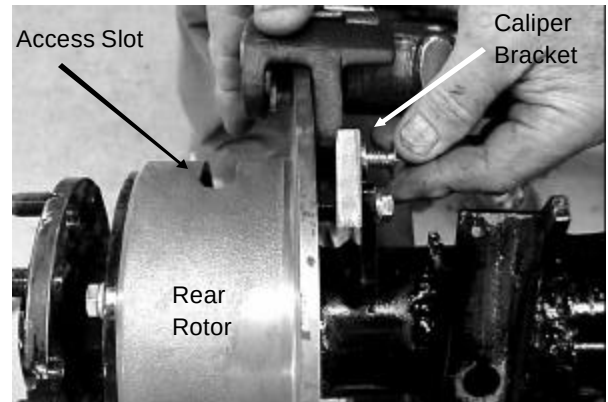


Figure 10 – Rear Rotor

Rotor Wear Limits

The limits for resurfacing of the brake rotor are 1/32 inch per side for a total of 1/16 inch. The overall thickness of the rotor should be no less than 3/16 inch.

HYDRAULIC SYSTEM

Check the brake fluid in the master cylinder periodically (under normal conditions, every 3 months). The master cylinder is located under the front deckboard and seat assembly.

Brake Fluid Maintenance

Note: Use DOT 3 Motor Vehicle Brake Fluid



CAUTION: Do not handle hydraulic system parts with greasy hands or permit parts to come in contact with oil or grease. Just a trace of grease or oil in the hydraulic system may cause damage to rubber parts.

HYDRAULIC SYSTEM (cont.)

Brake Fluid Maintenance (cont.)

- 1) Maintain fluid level within 1/4" of master cylinder filler opening.
- 2) Changing Brake Fluid
 - a) As a result of use, brake fluid loses some of its original qualities and may become contaminated. When performing major brake work to the hydraulic system, remove old fluid, and replace it with clean brake fluid.
 - b) Brake fluid must be changed following extended usage or contamination. Anytime fluid looks milky or dark, there are contaminants in the fluid.
 - c) If any of the hydraulic system parts are corroded or the fluid is discolored, flush the hydraulic system to remove old fluid; then fill with clean brake fluid.
- 3) Contamination. Soft or swollen rubber parts or milky or discolored fluid indicate the brake fluid is contaminated.
 - a) Drain old fluid from the system.
 - b) Replace cups and seals.
 - c) Flush hydraulic system with clean brake fluid.
 - d) Refill system with clean brake fluid.
- 4) Handling and Storing Brake Fluid
 - a) Keep the brake fluid clean. . Do not allow any foreign material in the fluid.
 - b) Prevent any petroleum product (gasoline, kerosene, oil, grease, etc.) from contaminating the brake fluid.
 - c) Use only clean containers for dispensing brake fluid. Do not use containers contaminated with dirt, oil, grease, rust, etc.
 - d) Always, cover or cap brake fluid containers when not actually dispensing the fluid. If containers are left open or uncovered, the fluid absorbs moisture from the air.
 - e) Never reuse old brake fluid drained from hydraulic system. Used brake fluid is contaminated to some extent.
 - f) Store brake fluid containers in a clean, dry place.



CAUTION: Before bleeding the hydraulic system, the cause of the problem should be diagnosed and properly repaired. If you find it necessary to bleed the brake system for any reason, check the fluid level in the master cylinder and add fluid as required. Use "DOT 3" fluid only.



CAUTION: Do not allow fluid to get on brake pads/rotors.

Bleeding The Hydraulic System



WARNING: Brake fluid can cause irritation of eyes and skin and may be harmful if swallowed. If fluid is swallowed, induce vomiting by administering two tablespoons of salt in a glass of warm water. Call a doctor. In case of contact with skin or eyes, flush with plenty of water. Get medical attention for eyes. **KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN!**

- 1) If any line or cylinder has been opened when servicing brake system or when satisfactory brake adjustment is unobtainable or pedal is spongy, bleed air from hydraulic system as follows:
- 2) Insert the end of a length of appropriate size plastic tubing over wheel cylinder bleeder nipple, located next to wheel cylinder line connection.
- 3) Place the other end in any clear glass jar containing about 1/2 inch of clean brake fluid.

HYDRAULIC SYSTEM (cont.)

Brake Fluid Maintenance (cont.)

- 4) Bleed right wheel first. Open bleeder nipple by rotating it counterclockwise about 1/2 turn. With master cylinder full of fluid at all times, slowly depress foot pedal repeatedly until fluid flows from bleeder nipple free of air bubbles.
- 5) Add fluid to master cylinder to bring to 1/4 inch from cover. Close bleeder nipple. Repeat above Add fluid to master cylinder to bring to 1/4 inch from cover. Close bleeder nipple. Repeat above procedure on left wheel.
 - a) Do not re-use fluid unless it is clear and free of sediment. If it is impossible to bleed all air from system, master cylinder is faulty and a master cylinder repair kit should be installed.
- 6) To purge the hydraulic system of remaining air bubbles, remove the bolts securing the caliper mounting bracket. Without removing the caliper and pads from the disc, rotate the caliper to position the bleed nipple in a vertical position. While holding caliper in this position, bleed system one last time.
- 7) Remount caliper to caliper mounting bracket. See Figure 10.

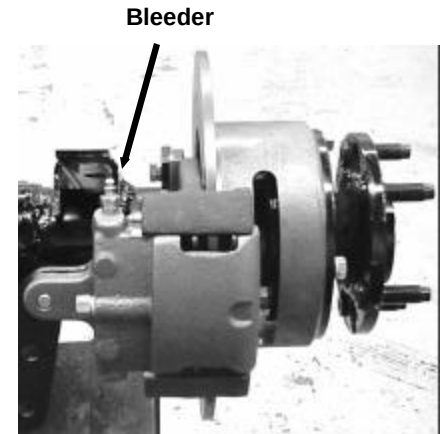


Figure 9 - Bleeder

WHEEL AND TIRE SERVICE

Wheel & Tire Removal

- 1) Place blocks ahead of and behind the wheels that will remain on ground.
- 2) Slightly loosen lug nuts.
- 3) Place a jack under the side of the vehicle just ahead of the rear wheel or behind the front wheel so it will come in contact with the frame. Raise the vehicle until the tire clears the ground.
- 4) Place Jack Stand's under unibody for additional safety.
- 5) Remove lug nuts and wheels.

Wheel & Tire Replacement

- 1) To install wheel to hub, reverse above procedures and run the lug nuts up to the wheel by hand until all nuts are snug against the wheel and the wheel is up against the brake drums.
- 2) Tighten the lug nuts evenly in a star pattern until the nuts are all seated and torque to 50-60 ft. lbs.

! CAUTION: The lug nuts must be lightly snugged in a star pattern, then torqued in a crossing pattern or the wheel may be bent, causing it to wobble.

! CAUTION: Replacement tires must be of the same size as original equipment. Increased Tire load ratings are permissible but the tire rating does not increase the vehicles rated load carrying capacity of the vehicle.

Tire Care

1. Improper inflation will shorten the life of your tires and will adversely affect performance. For proper tire inflation refer to manufacturer's recommendation imprinted on tire sidewall. Initial factory setting is 35 to 50 psi. NOT to exceed tire sidewall rated capacity of 75 psi at full load.

LUBRICATION

Differential

The lubricant level in the differential should be checked upon receipt of vehicle, then every 6 months. If lubricant is needed, use SAE 80 gear oil. Do not overfill. Lubricant should not go above the bottom of the filler plug hole when the vehicle is level. 72 Oz in the automotive axle, 44 Oz in M-18 Dana axle.

Wheel Bearings

Clean, inspect and lubricate wheel bearings every 6 months. Use "Texaco Marfax" heavy duty #2 or equivalent. Replace worn bearings as needed.

Steering Gear

Check yearly; add grease as required (Molub-Alloy #0 or equivalent).

Note: Replace Steering Cover Gasket

Chain Cover

Check yearly, add grease in center along length as required (Molub-Alloy #0 or equivalent).

Pivot Points With Grease Fittings

There are 6 lubrication points with grease fittings on the front end of the vehicle — one on each of the four tie rod ends and one on each side of the front axle (kingpin pivot). Under normal conditions, these points should be greased every 6 months with chassis lube

Pivot Points Without Grease Fittings

The handbrake mechanism, parking brake linkage and brake pedal lever pivot should be lubricated every 3 months. Use light machine oil or motor oil.

BODY AND CAB MAINTENANCE

Body

Frequent washings with mild soap will preserve the luster and finish of your vehicle. For stubborn and imbedded dirt, a soft bristle brush may be used. Tar, asphalt, creosote and the like should be removed immediately to prevent staining of paint.



WARNING: Avoid direct hose spray on electrical components.

Upholstery

Clean gently with mild soap suds and a soft cloth.

Cab

The Columbia Industrial Vehicle cab (optional) is constructed of reinforced fiberglass or painted steel. Use a mild soap or detergent with a sponge or soft cloth for normal cleaning.

BODY AND CAB MAINTENANCE (Cont.)



WARNING: Do not use harsh detergents, abrasives or cleaning solvents that contain ammonia, aromatic solvents or alkaline material to clean cab.

Windows

Normal window cleaners may be used on glassed areas of cab.

CHAPTER 4

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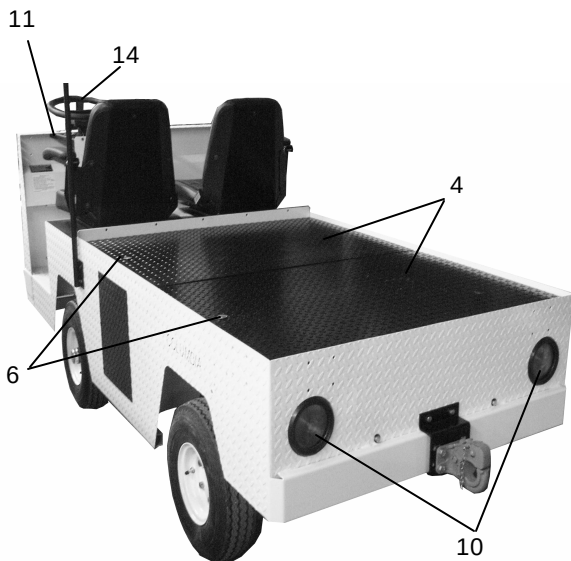
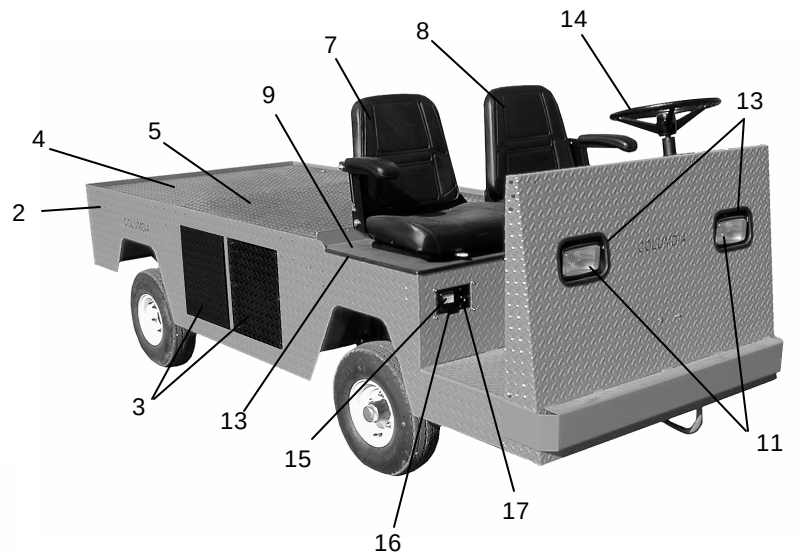
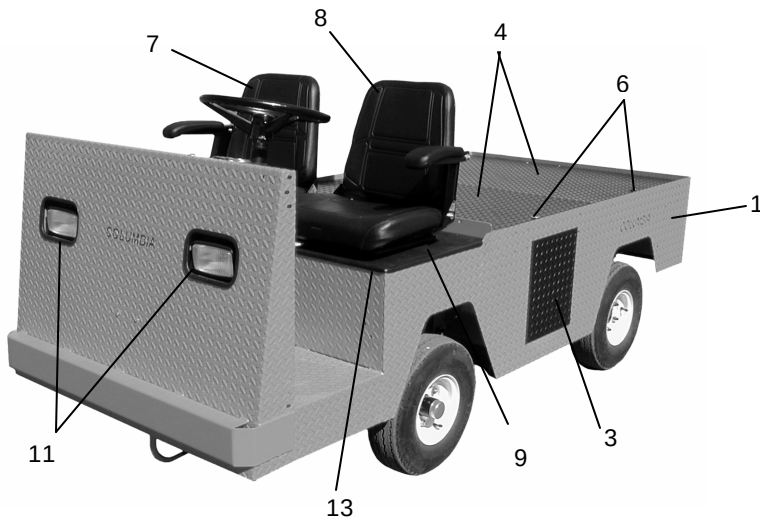
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BODY ITEMS

Note: The Burden Carriers come in two bed lengths Standard (62 inches length) and the Extended Bed (XB, 76 inches in length). For ease in recognition they will be designated in some parts list tables as STD and XB.

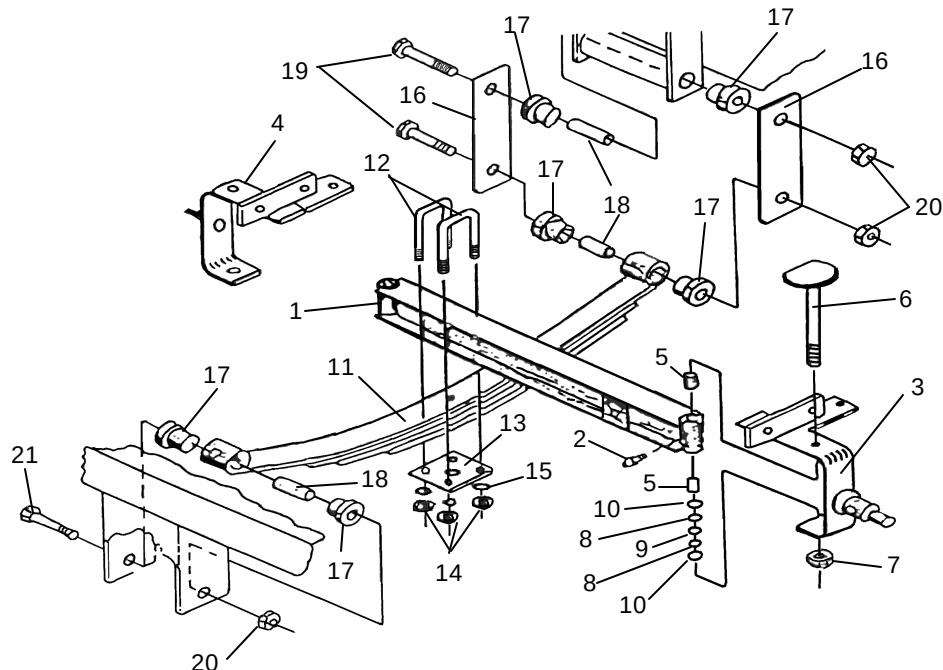


Body Items

Body Items				
Item	Part #	Description	Qty Used	
			STD	XB
1	19311-00	Body Frame, Complete 62" Bed	1	
2	19501-00	Body Frame, Complete 76" Bed		1
3	47993-00	Cover Battery Compartment	2	4
*	8211	Rivet, Cover Mounting	12	24
4	51322-00	Cover Deckboard, Short	2	1
	51320-00	Deckboard, Short	2	1
5	51323-00	Cover Deckboard, Long		1
	51321-00	Deckboard, Long		1
*	53284-00	Label Set, Burden Carrier	1	1
6	1600	Bolt, Flat Lifting 5/16-18x2 1/2"	2	2
*	6000-B	Washer, 5-16	2	2
*	7739	Locknut, Nylok 5/16-18	2	2
7	51700-00	Seat Assy., RH, Complete (W/O switch)	1	1
8	51701-00	Seat Assy., LH, Complete (With switch)	1	1
9	51325-00	Seatboard	1	1
*	7739	Locknut, Nylok 5/16-18 (Seat Mounting)	8	8
	6000-B	Washer, 5-16 (Seat Mounting)	8	8
10	68020-92	Tail Lamp, 4" Round	2	2
11	67724-91	Headlight	2	2
12	68860-00	Signal, Turn Kit		
13	48880-ZZ	Windlace Trim (Order by foot)	*	*
*	11491	Plug, 2 3/32" (When Hour Meter is not used)	1	1
*	11491	Plug, 3" (When Battery Discharge Indicator is not used)	1	1
*	51324-00	Cover, Cowl Wiring	1	1
*	3787-B	Bolt, 1/4-20 x 3/4" (Cowl Cover Mounting)	2	2
*	7742	Locknut, Nylok 1/4-20 (Cowl Cover Mounting)	2	2
*	6703-B	Washer (Cowl Cover Mounting)	2	2
14	57069-84	Steering, Wheel	1	1
*	57089-99	Scorecard, Holder	1	1
*	2641	Screw, Pan Hd #10x1"	3	3
*	7995	Locknut, Nylok Thin 5/8-18	1	1
15	69743-00	Console, Charger Control	1	1
16	69802-00	Ammeter	1	1
17	69735-00	Receptacle, AC Cord	1	1
*	66493-67A	Cord, Extension	1	1
* Not pictured in Illustration				

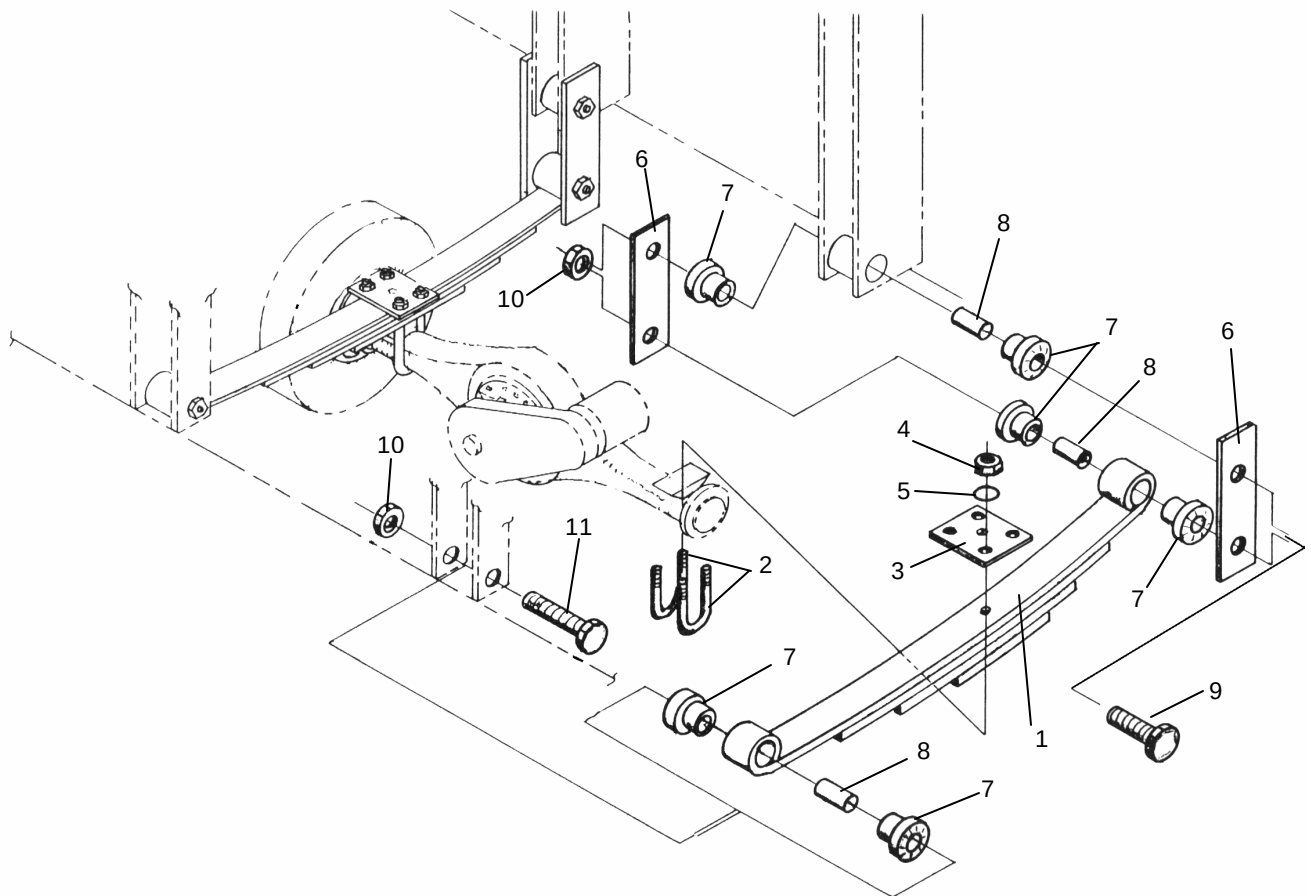
Front Axle & Suspension

Front Axle & Suspension			
Item	Part #	Description	Qty
	19503-00	Front Suspension Group	
1	54827-00	Assembly, Axle Beam	1
2	9800	Fitting, Grease (Axle)	2
3	56864-00	Assembly, Spindle LH	1
4	56863-00	Assembly, Spindle RH	1
5	9083	Bushing, Kingpin	4
6	56843-00	Assembly, Kingpin	2
7	7513	Nut, Kingpin	2
8	6042	Washer, Thrust	4
9	9085	Bearing, Thrust	2
10	11100	"O" Ring	4
11	54814-00	Assembly, Spring (4 Leaf)	2
*	54818-00	Assembly, Spring (6 Leaf)	2
*	54819-00	Assembly, Spring (7 Leaf)	2
12	5203	"U" Bolt, Front Axle 1/2-13x5 1/4" (4 Leaf Spring)	4
	5209	"U" Bolt, Front Axle 1/2-13x5 7/8" (6 & 7 Leaf Spring)	4
13	54800-00	Plate (Spring to Front Axle)	2
14	7880	Nut, Hex 12-13 ("U" Bolt to Spring)	8
15	7068	Lockwasher, 1/2 ("U" Bolt to Spring)	8
16	54801-00	Shackle (Spring to Frame)	4
17	10505	Bushing (Spring to Frame)	12
18	5711	Spacer (Spring to Frame)	6
19	3453	Screw, Hex Cap 3/8-16 x 3 3/4" (Spring to Frame)	4
20	7778	Locknut 3/8-16, (Spring to Frame)	6
21	3416	Screw, Hex Cap 3/8-16x3 1/2" (Spring to Frame)	2
* Not pictured in Illustration			



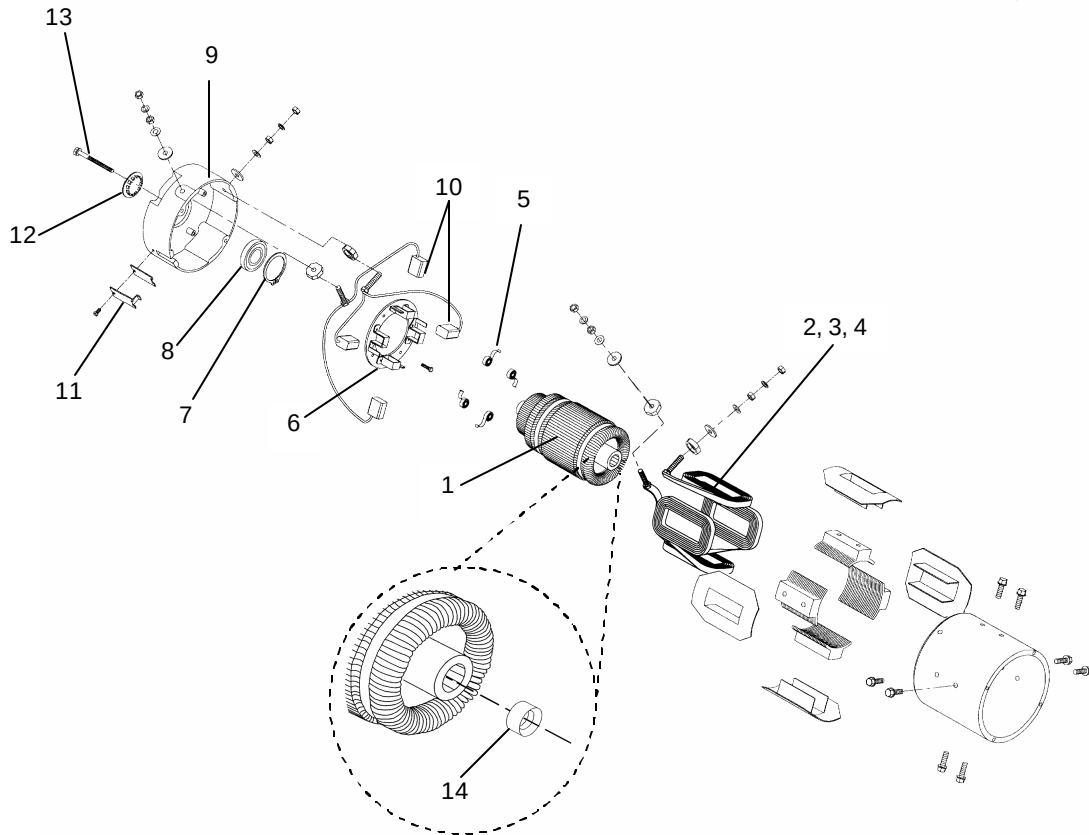
Rear Suspension

Rear Suspension			
Item	Part #	Description	Qty
1	54814-00	Spring Assy., 4 Leaf (BC3-21, BC4-18, BC3-30, BC4-25 & XB Models)	2
	54819-00	Spring Assy., 7 Leaf (BC3-40, BC4-35 & XB Models)	2
	54836-00	Spring Assy., 8 Leaf (BC3-50 & BC4-45 XB Models)	2
2	5204	"U" Bolt, Rear Axle	4
	5214	"U" Bolt, Rear Axle (6 & 7 Leaf sizes)	4
	5213	"U" Bolt, Rear Axle (8 Leaf sizes)	4
3	54815-00	Plate, Spring to Rear Axle	2
4	5880	Nut, "U" Bolt to Spring	8
5	7068	Lockwasher, "U" Bolt to Spring	8
6	54801-00	Shackle, Spring to Frame	4
7	10505	Bushing, Spring to Frame	12
8	5711	Spacer, Spring to Frame	6
9	3453	Screw, Hex Cap 3/8-16 x 3 3/4" (Spring to Frame)	4
10	7778	Locknut, 3/8-16 (Spring to Frame)	6
11	3416	Screw, Hex Cap 3/8-16x3 1/2" (Spring to Frame)	2



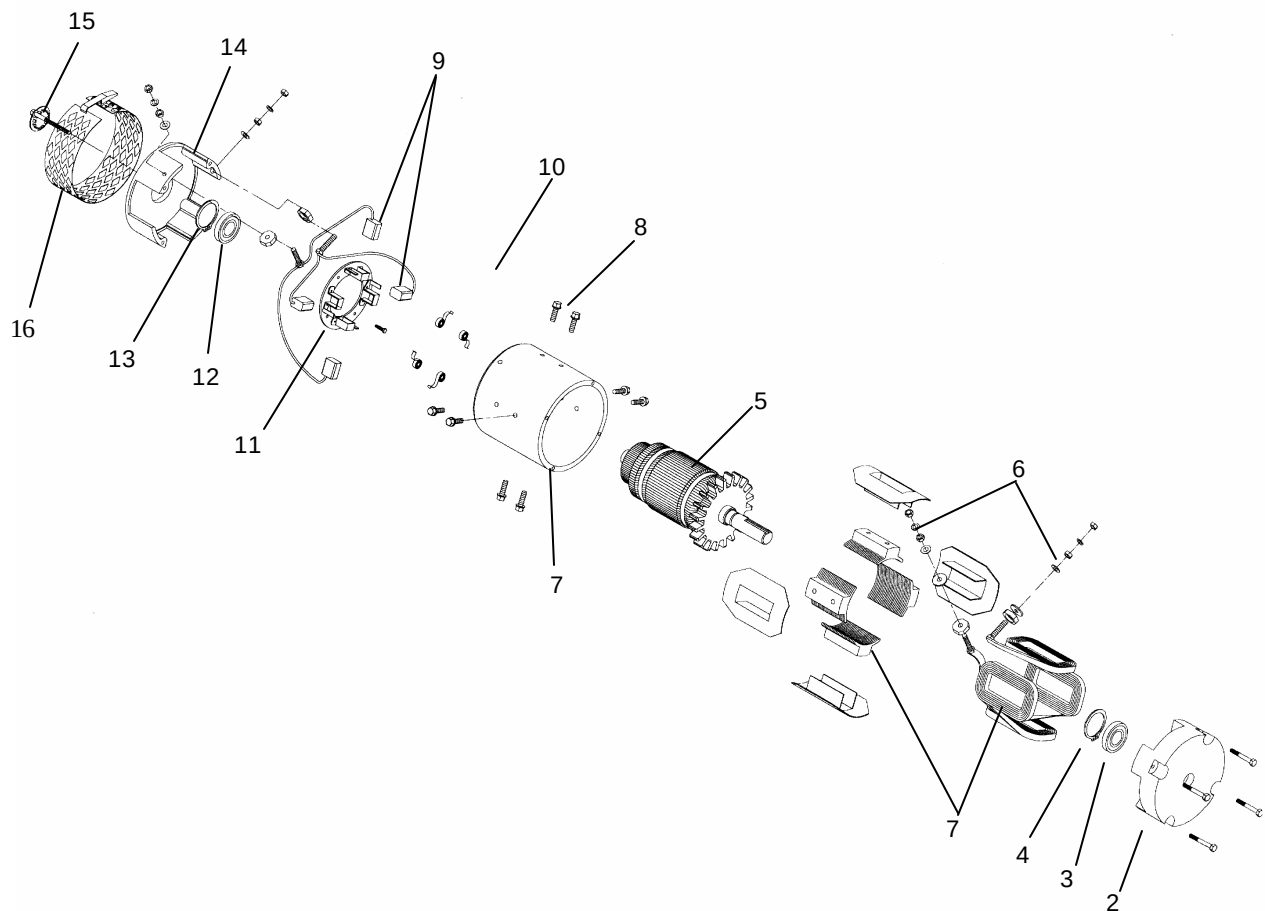
Motor, Traction Direct Drive

Motor, Advanced DC (Direct Drive)			
Item	Part #	Description	Qty
	69201-00	Motor, Complete	
1	83281-89A	Armature Assy.	1
2, 3, 4	83282-89A	Kit, Field Coil	1
5	83287-89A	Spring, Brush	4
6	83284-89A	Brush Plate & Box Assy.	1
7	83285-89A	Ring, Snap	1
8	83286-89A	Bearing	1
9	83288-89A	Commutator, Endhead	1
10	83283-89A	Set, Brush	2
11	N/A	Cover Plate Assy.	1
12	83290-89A	Plug, End Cap	1
13	83291-89A	Bolt, End Cap	2
14	11423	Resilient Bumper, Electric Motor	1



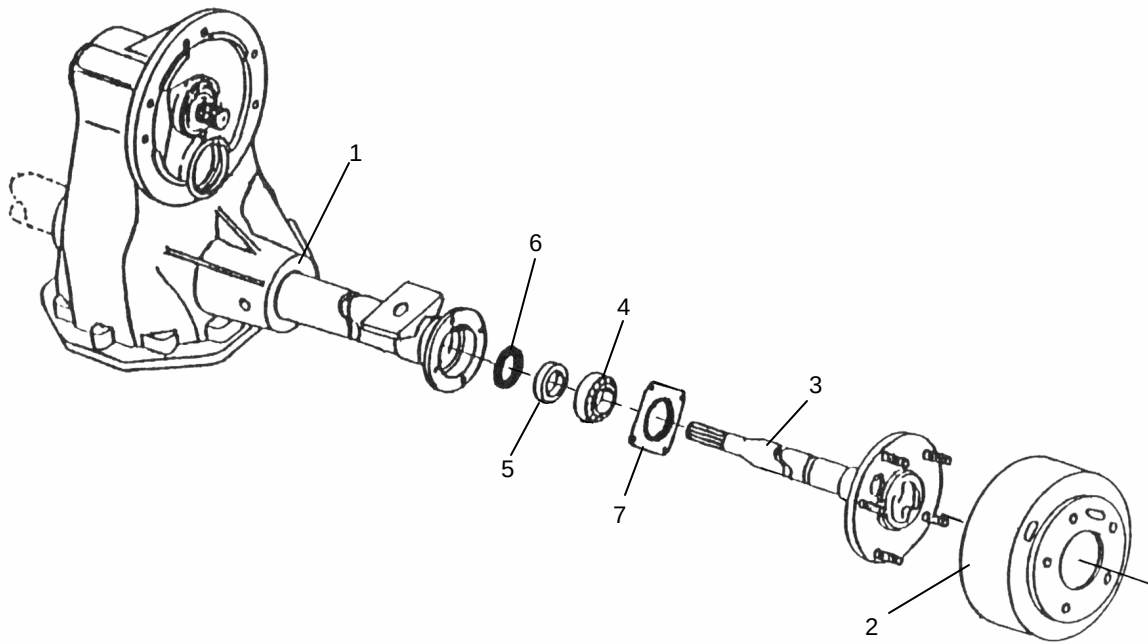
Motor, Traction Chain Drive

Motor, Advanced DC (Chain Drive)			
Item	Part #	Description	Qty
	69401-00	Motor, Complete	1
1	N/A	Seal	1
2	N/A	Endhead, Drive	1
3, 12	83286-89A	Bearing	2
4	83285-89A	Ring, Snap	1
5	N/A	Armature & Fan Assy.	1
6	N/A	Nut & Washer Package	1
7	N/A	Frame & Field Coil Assy.	1
8	N/A	Screw, Pole	8
9	83301-00	Brush	4
	83283-89A	Kit, Lead Assembly	4
10	11839	Spring, Brush	4
11	83284-89A	Brush Plate & Box Assy.	1
13	N/A	Washer, Wavy	1
14	N/A	Commutator Endhead	1
15	83290-89A	Plug	1
16	N/A	Headband Assy.	1



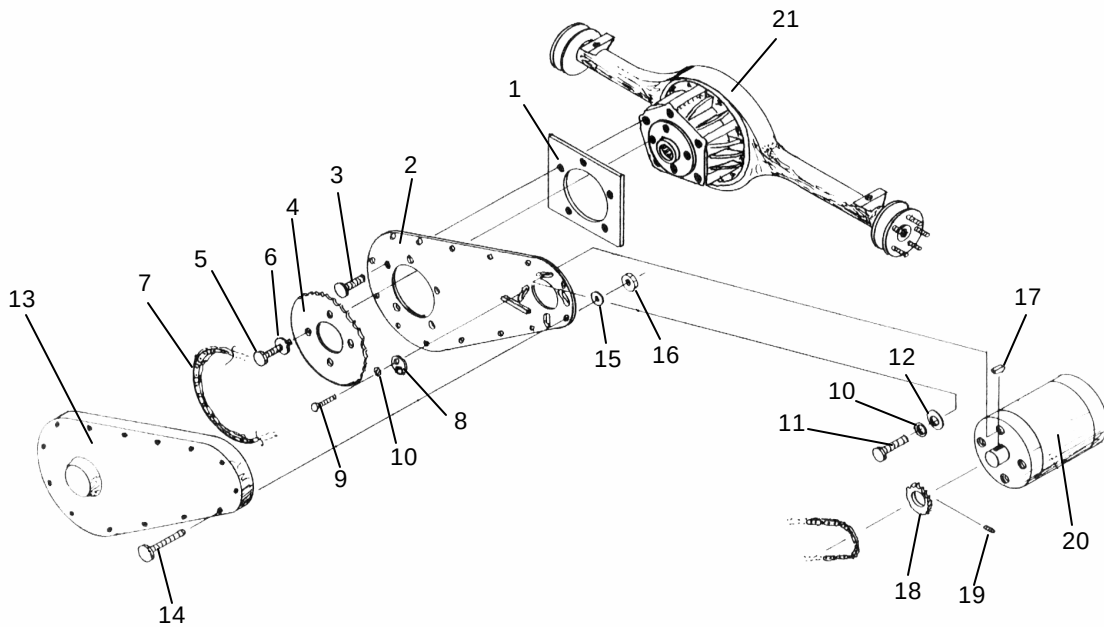
Drive System

Differential, Drive System			
Item	Part #	Description	Qty
1	33437-00	Rear Axle Assy. (Less Motor)	1
2	82830-93	Drum, Brake	2
3	82758-00	Axle Shaft, LH (Long)	1
*	82757-00	Axle Shaft, RH (Short)	1
4	82739-87	Bearing, Axle	2
5	83167-93	Retainer, Bearing	2
6	82811-93	Seal, Inner	2
7	83160-93	Seal, Outer Axle	2
*	82885-00	Axle Complete W/Weldments	1
* Not Pictured in Illustration			



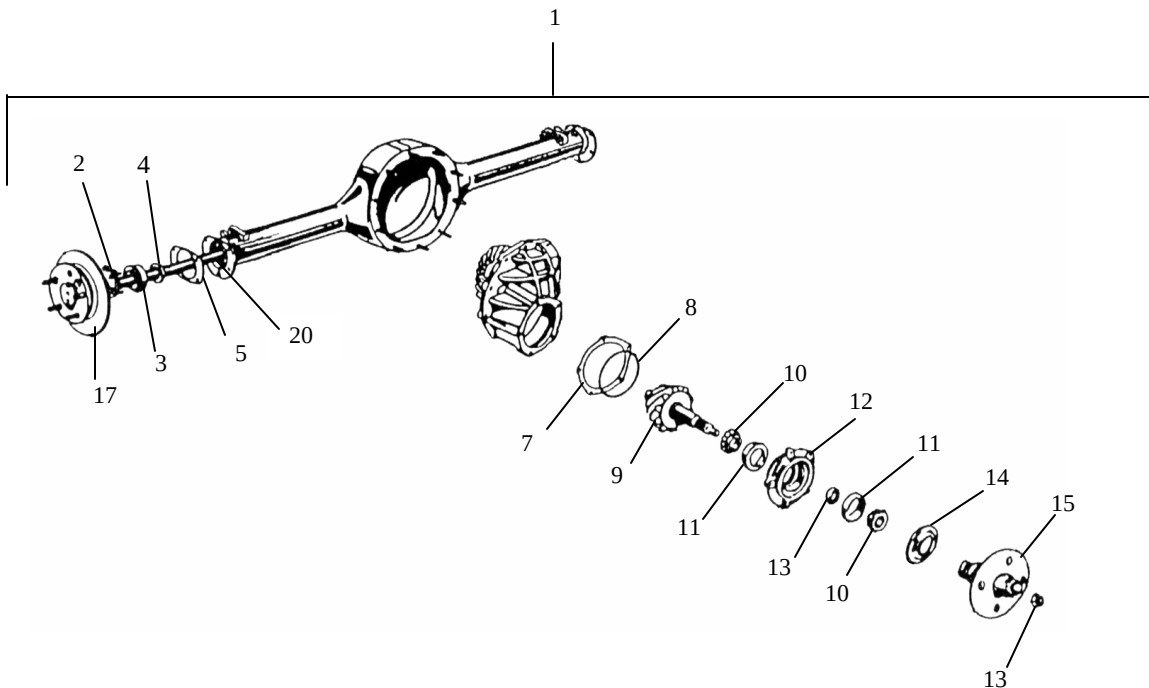
Drive System (cont.)

Sprockets/Motor/Chain Drive System			
Item	Part #	Description	Qty
1	33414-00	Plate, Adapter (Backing Plate to Differential)	1
2	33415-00	Backing Plate, Chain Housing	1
3	4740-B	Screw, Cap 3/8-16 x 2" (Backing Plate to Differential)	5
4	33432-00	Sprocket, 67 Tooth	1
*	33417-00	Sprocket, 86 Tooth	1
5	2879-W	Screw, Cap 3/8-16 x 1" (Sprocket to Flange)	4
6	7038-B	Washer, Lock(Sprocket to Flange)	4
7	33441-00	Chain, 45 Link	1
*	33407-00	Chain, 52 Link	1
8	33420-00	Adjuster, Chain Tension	1
9	4716-W	Screw, Cap 3/8-16 x 1 1/4"	1
10	7038-B	Washer, Lock 3/8	4
11	2879-W	Screw, Cap 3/8-16 x 1"	3
12	6416	Washer, Flat 3/8	3
13	33405-00	Housing, Chain	1
14	3413	Screw, Cap 1/4-20 x 3 1/4"	14
15	6040	Washer, Flat 1/4	14
16	7742	Locknut, 1/4 x 20	14
17	41204-63A	Key, Sprocket to Motor	1
18	33411-00	Sprocket, 17 Tooth	1
*	33472-00	Sprocket, 19 Tooth	1
19	2247	Screw, Set, Sprocket to Motor	1
20	69401-00	Motor (See "Motor" Page 4-7 for Detail)	1
21	33402-00	Differential (See page 4-10 for Detail)	1
* Not Pictured in Illustration			



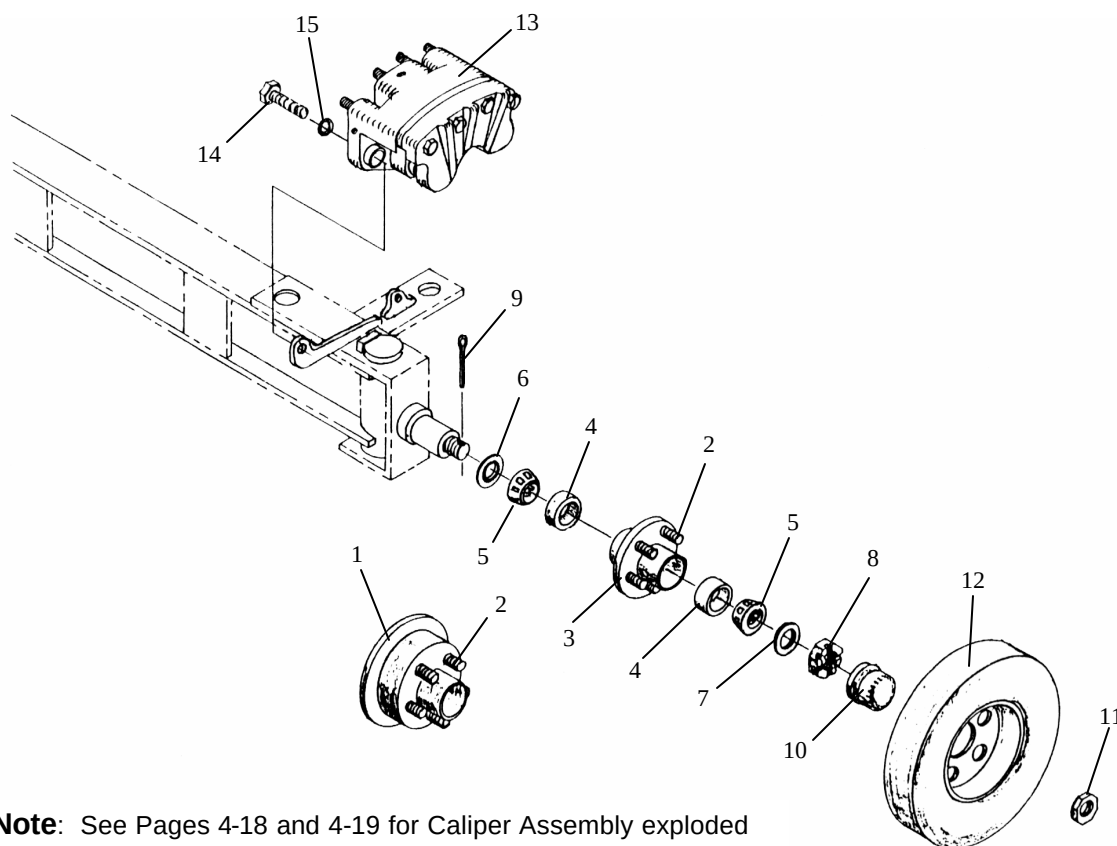
Differential Assembly

Assembly, Differential			
Item	Part #	Description	Qty
1	33402-00	Differential	1
2	82516-00	Axle/Bearing Retainer	2
3	9082	Bearing, Axle	2
4	N/A	Retainer Ring, Bearing (Supplied with Bearings)	2
5	82507-00	Gasket, Plate (To Housing)(Not required for 10" Wheel)	2
6		Housing, Axle	1
*	7778	Locknut, 3/8-16 (Axle/Bearing Retainer to Housing)	8
9	N/A	Shim (Supplied with Center Section)	1
10	82505-00	"O" Ring	1
11	N/A	Pinion, Drive (Supplied with Center Section)	1
12	9084	Bearing, Pinion	2
13	9024	Race, Pinion Bearing	2
14	N/A	Retainer, Pinion (Supplied with Center Section)	1
15	82504-00	Sleeve	1
16	12013	Seal, Pinion	1
17	33418-00	Flange, Sprocket	1
18	N/A	Nut, Sprocket Flange (Supplied with Center Section)	1
19	41238-00	Rotor	2
20	82704-00	Inner Oil & Grease Seal	



Front Rotor, Hub, Wheels & Tires

Front Rotor, Hub, Wheel & Tires			
Item	Part #	Description	Qty
1	41291-00	Rotor, Front Assembly	2
2	41200-94	Bolts, Wheel Lug	10
*	41279-00	Rotor (8" Wheel, 10" Disc)	2
3	33419-00	Hub, Kit Assembly	2
4	9028	Cup, Bearing Ra	4
5	9087	Cone, Bearing	4
6	12020	Seal, Hub	2
7	6038	Washer (Bearing Retainer)	2
8	7510	Nut, Spindle 1"-14	2
9	561	Pin, Cotter	2
10	33438-00	Cover, Dust	2
11	43152-66	Nut, Lug 1/2-20	10
12	40998-00	Wheel & Tire 18" 5.70/500 x 8 Range "C"	4
*	41010-00	Kit, Wheel & Tire 18" 8.50 x 8 Range "B"	4
*	40993-00	Tire & Wheel Assy. Solid Tire, Lug Tread (Optional)	4
*	19368-00	Kit, Front Brakes	2
13	41267-00	Caliper, Left Front (For Front Wheel Brake Option Only)	1
*	41268-00	Caliper, Right Front (For Front Wheel Brake Option Only)	1
14	4713-W	Screw, Hex Cap 3/8-16x3/4")	4
15	7038-B	Lock washer 3/8	4

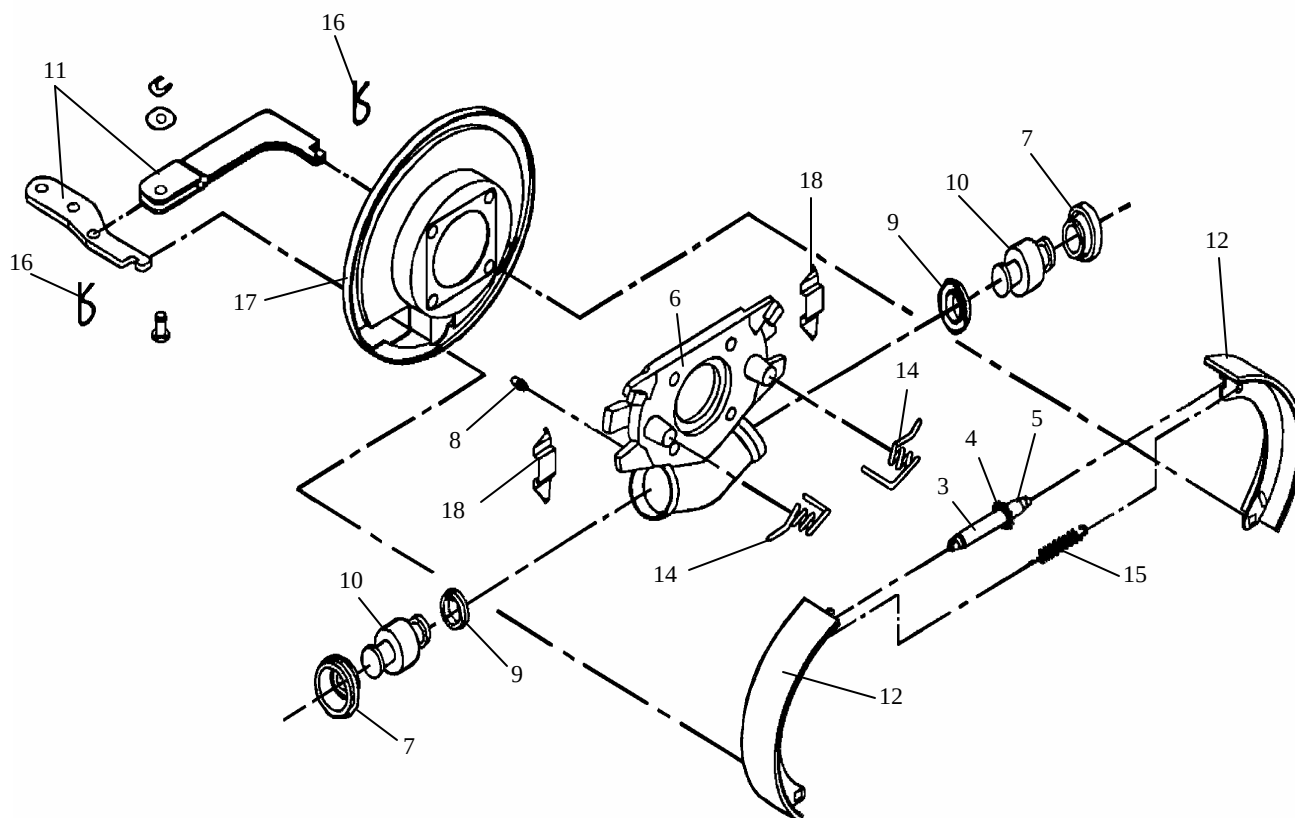


Note: See Pages 4-18 and 4-19 for Caliper Assembly exploded views

Hydraulic Drum Brakes Light Duty

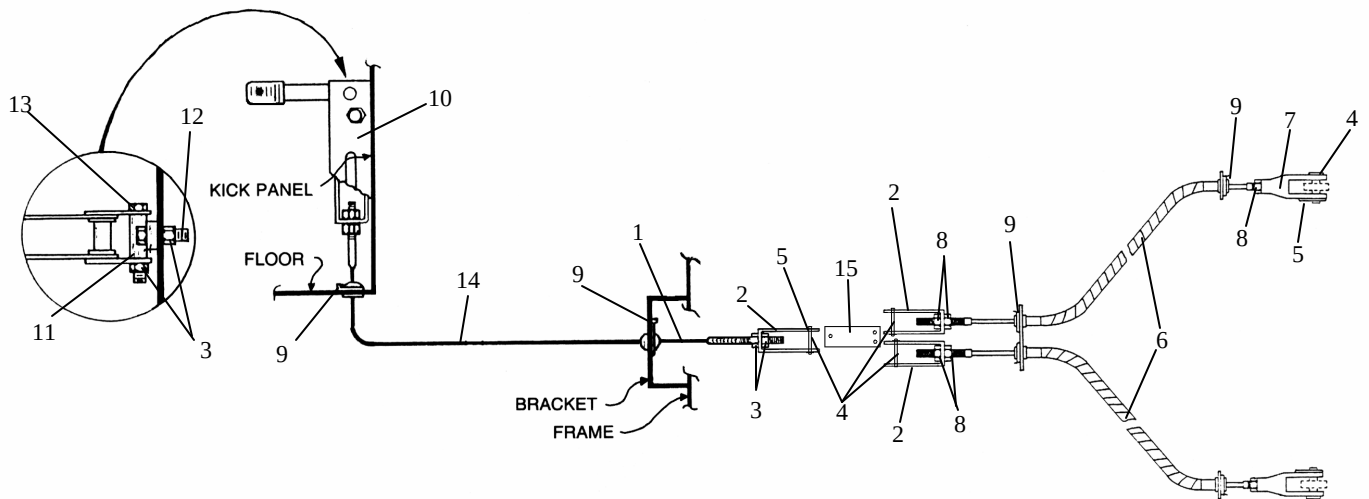
Hydraulic Drum Brakes			
Item	Part #	Description	Qty
1*	41813-93	Assembly, Brake LH Compl. (Incl. Items 3 - 18)	1
2*	41814-93	Assembly, Brake RH Compl. (Incl. Items 3 -18)	1
3	41878-93	Adjusting Screw	1
4	41880-93	Nut, Pivot (Adj, Screw)	1
5	41882-93	Socket, Adj. Screw	1
6*	41884-93	Spider, Torque	1
7	41886-93	Boot & Ring (Wheel Cylinder)	2
8	41888-93	Screw, Bleeder	1
9	41890-93	Cup, Hydraulic	2
10	41892-93	Piston, Wheel Cylinder	2
11	41894-93	Strut & Lever, Assembly (Parking Brake)	1
12	41912-93	Set, Shoe & Lining Assembly	1
13	41914-93	Spring, Shoe Return LH (Green)	1
14	41916-93	Spring, Shoe Return RH (Red)	1
15	41918-93	Spring, Adj. Screw	1
16	41920-93	Pin, Retainer (Parking Brake Lever)	2
17*	41926-93	Shield, Dust	1
18	41928-93	Spring, Shoe Hold Down	2

* When Repairing Items 1, 2, 6 OR 17 Rear Axle Disassembly and Repair Parts Will be Required.



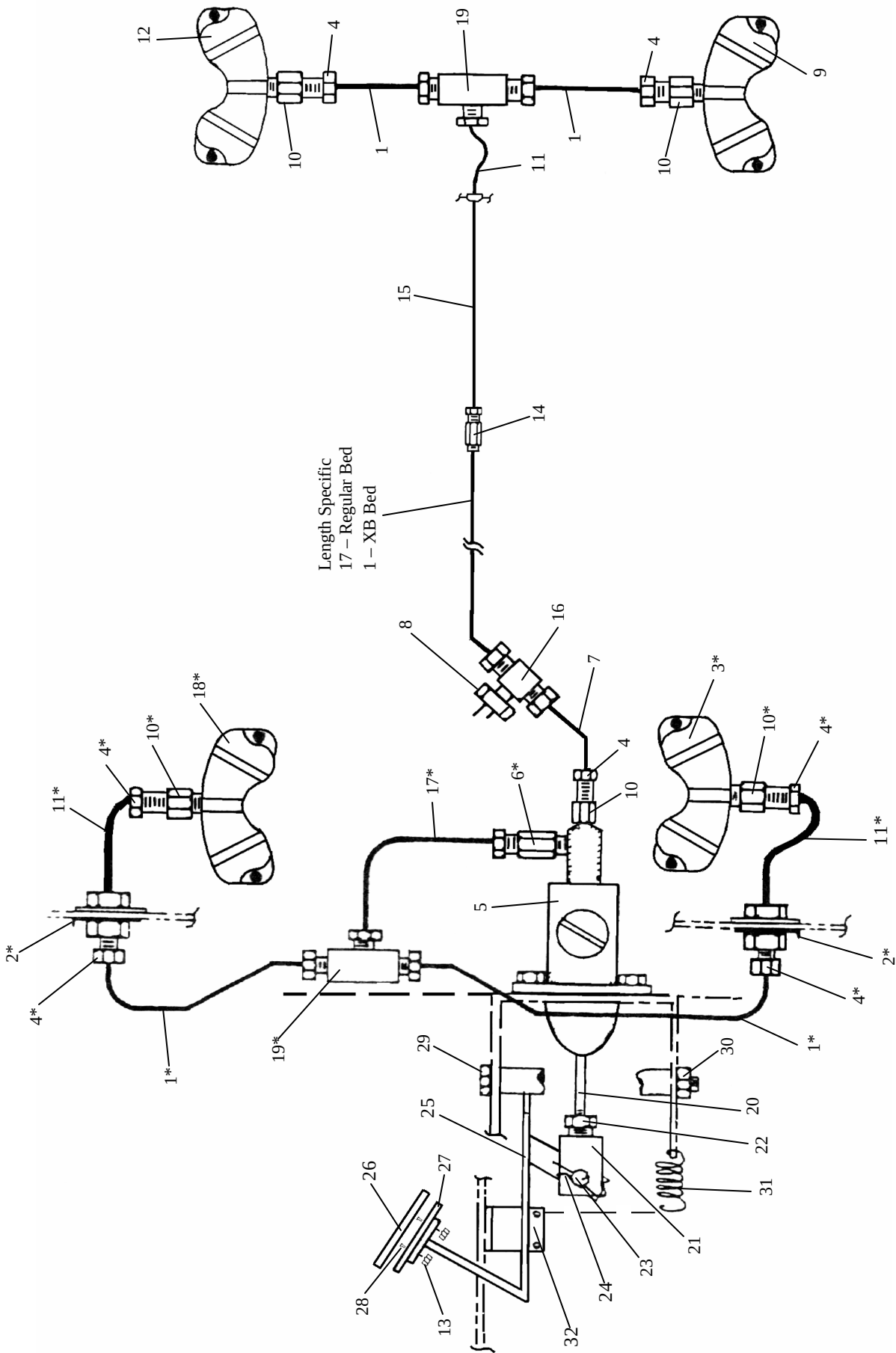
Parking Brake Linkage

Brake Linkage			
Item	Part #	Description	Qty
1	41342-00	Rod, Pull	1
2	73065-00	Clevis	4
3	7748-B	Nut, UNC-2B 5/16-18	4
4	494	Pin, Clevis 5/16 x 1"	5
5	500	Pin, Hitch #13	5
6	41215-00	Cables, Brake Rear	3
7	73059-96	Clevis	2
8	7753	Nut, Hex Hd 5/16-24	6
9	41209-00	Clip, Brake Cable	5
10	41213-00	Brake, Hand Assembly	1
11	41231-0	Bracket, Handbrake Mount	1
12	3987-BS	Screw, Black 5-16-18 x3/4" (Bracket to Kick Panel)	2
13	2818	Screw, Hex Cap 5/16-18 x 1 1/2"	2
14	41215-00	Cable, Handbrake to Rear Cable	1
15	41227-00	Bar, Parking Brake Extension 17 1/2" (XB Models)	1
*	41202-00	Bar, Parking Brake Extension 3" (62" Bed Models)	1
* Not Pictured in Illustration			



Brake - Hydraulic System

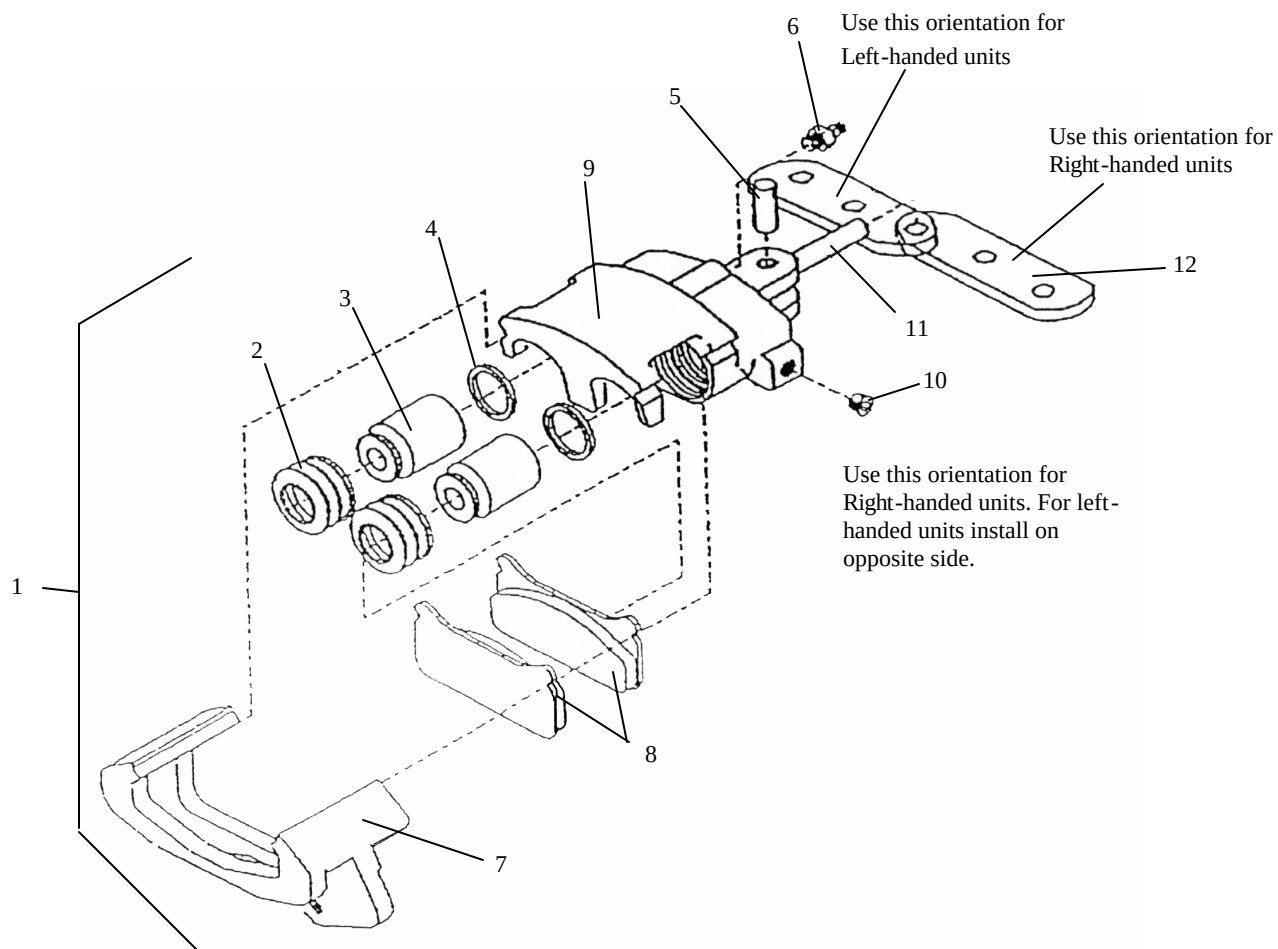
Hydraulic Disc Brake System			
Item	Part #	Description	Qty
1	41222-00	Brake Line, 20" (Rear Disc Brakes)	3
*	41222-00	Brake Line, 20" (Front 4 Wheel Disc Brakes) (XB requires 3)	2
2	9959	Clip, Hose (Hose to Frame for Front Brakes)	2
3	41267-00	Caliper, L Front Brake	1
4	41275-00	Elbow, Male (Brake Line to Caliper)	2
5	41207-00	Master Cylinder (4 & 2 Wheel Drum Brakes) (4 Hole Mounting)	1
*	41259-00	Master Cylinder (4 & 2 Wheel Disc Brakes) (4 Hole Mounting)	1
*	41203-00	Master Cylinder (2 Wheel Disc & Drum Brakes) (2 Hole Mounting)	1
6	41221-00	Reducer, Adapter (Master Cylinder to Brake Line)	2
7	41223-00	Brake Line 6"	1
8	41212-00	Switch, Stoplight	1
9	41225-00	Caliper, L Rear Brake	1
10	41224-00	Connector, Brass (Brake Line to Caliper Rear)	2
11	41216-00	Hose, Brake Hydraulic	1
12	41226-00	Caliper, R Rear Brake	1
13	7686	Nut, Nylok 1/4-20	2
14	41206-00	Union, Inverted Flair (Mid, Rear)	1
15	41220-00	Brake Line 60" (XB Only)	1
*	41269-00	Brake Line 51" (Standard Bed Only)	1
16	41333-00	T-Fitting Hydraulic W/Brkt (To Stoplight Switch)	1
17	41219-00	Brake Line 10"	1
18	41268-00	Caliper, R Front Brake	1
19	41842-94	Union, Tee 3/16" Hyd Brake	2
20	41230-00	Rod, Threaded Master Cylinder	1
21	75059-96	Yoke	1
22	7744	Nut, Jam 5/16-24	1
23	494	Pin, Clevis 5/16x1"	1
24	500	Pin, Hitch #13	1
25	41229-00	Lever, Brake Pedal Assembly	1
26	42407-00	Pad, Brake Pedal	1
27	41350-00	Plate, Brake Pedal Mounting	1
28	2008	Screw, Flat Hd.1/4-20x5/8" (Brake Pedal Plate Mounting)	2
29	2828-W	Screw, Hex Cap 3/8-16x3" (Brake Pedal Assy. Mounting)	1
30	7778	Locknut, Nylok 3/8-16 (Pedal Assy. Mounting)	1
31	11833	Spring, Brake Return 3/8x5"	1
32	41232-00	Bracket, Spring Mounting	1
*		Front Wheel Kit (Incl. Items 1, 2, 3, 4, 6, 10, 11, 17, 18 & 19)	1
* Not pictured in Illustration			



Items with asterisk (*) are used with front wheel brakes.

Brakes, Rear Caliper Assembly

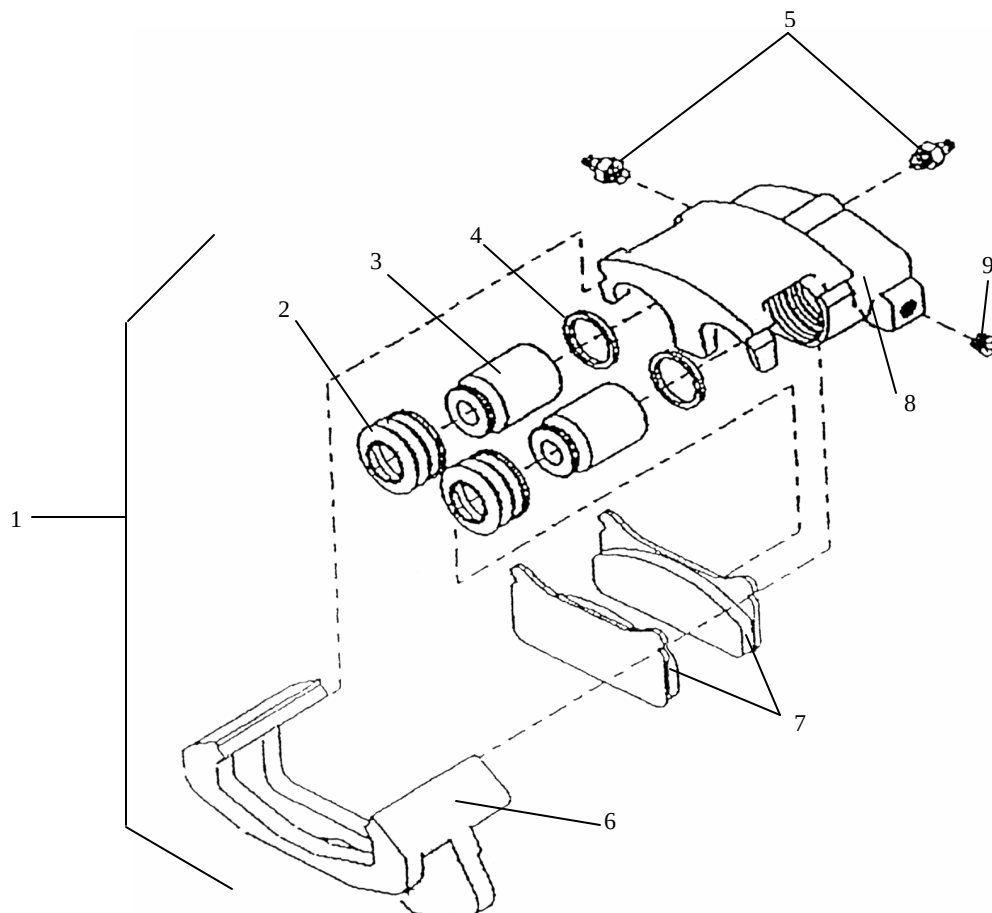
Calipers, Rear Brake			
Item	Part #	Description	Qty
1	41225-00	Assembly, Caliper L Rear	1
*	41226-00	Assembly, Caliper R Rear	1
2	41361-00	Boot, Dust	2
3	41259-00	Piston	2
4	41360-00	"O" Ring	2
5	N/A	Pin	1
6	41313-00	Bleeder	1
7	N/A	Caliper Carrier, Lower	1
8	41297-00	Brake Pads	2
9	N/A	Caliper Carrier, Upper	1
10	41224-00	Connector, Male Brass	1
11	N/A	Parking Brake Actuating Pin	1
12	41257-00	Lever	1



Brakes, Front Caliper Assembly

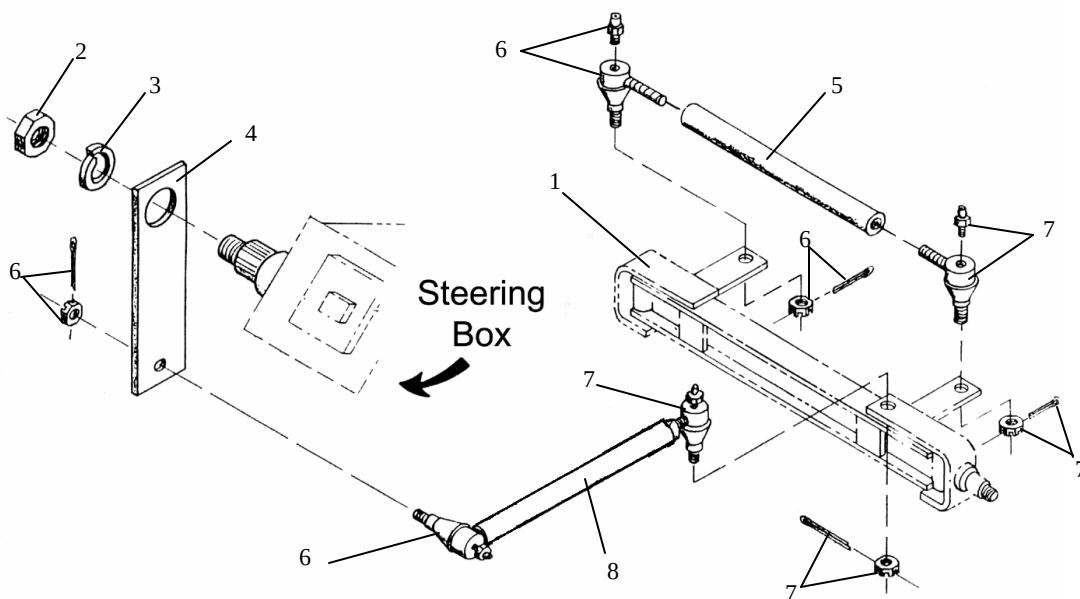
Calipers, Front Brake			
Item	Part #	Description	Qty
1	41267-00	Assembly, Caliper L Front	1
*	41268-00	Assembly, Caliper R Front	1
2	41361-00	Boot, Dust	2
3	41359-00	Piston	2
4	41360-00	"O" Ring	2
5	41313-00	Bleeder	1
6	N/A	Caliper Carrier, Lower	1
7	41297-00	Brake Pads	2
8	N/A	Caliper Carrier, Upper	1
9	41224-00	Connector, Male Brass	1

Note: Bleeder may be placed in any of 3 locations



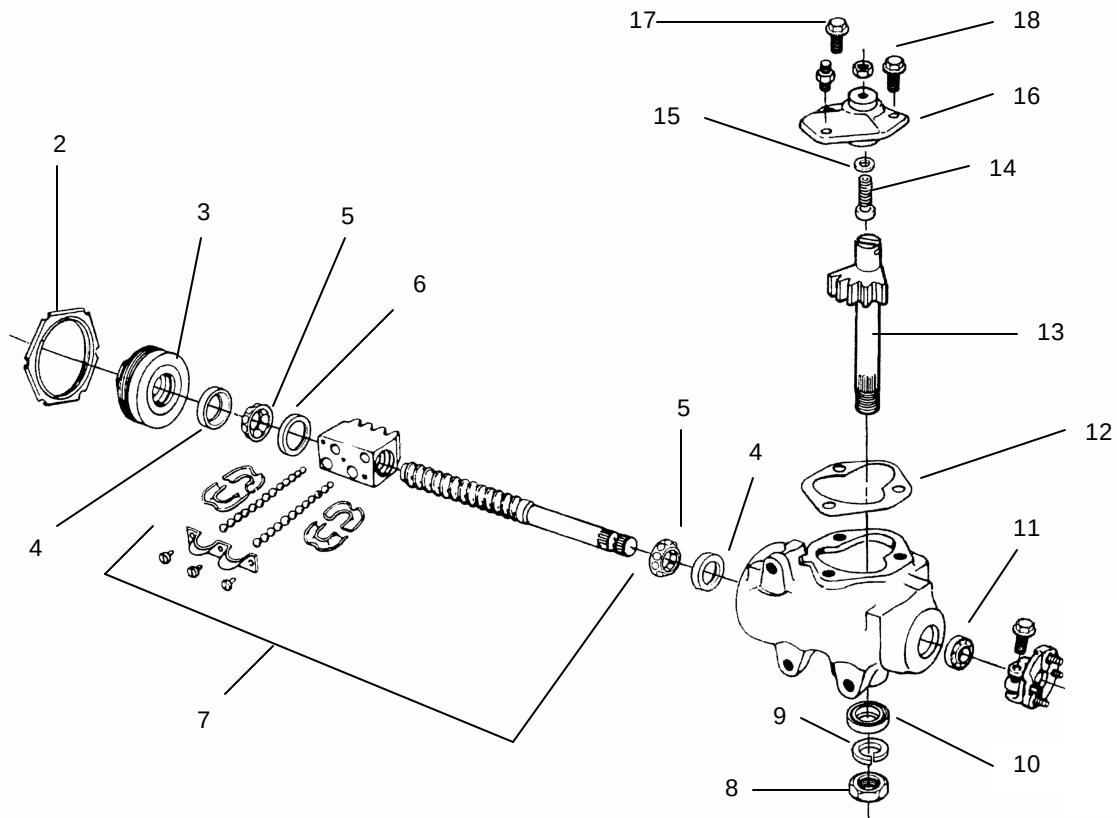
Steering Linkage

Steering Linkage			
Item	Part #	Description	Qty
1	54827-00	Axle Beam, Weldment	3
2	N/A	Nut (Supplied with Steering Box)	1
3	N/A	Washer, Lock (Supplied with Steering Box)	1
4	56817-00	Pittman Arm	1
5	56816-00	Tie Rod	1
6	56802-00	Tie Rod End, RH (Includes Boot, Lube Fitting, Nut, & Cotter Pin)	2
7	56804-00	Tie Rod End, LH (Includes Boot, Lube Fitting, Nut, & Cotter Pin)	2
8	56814-00	Drag Link	2



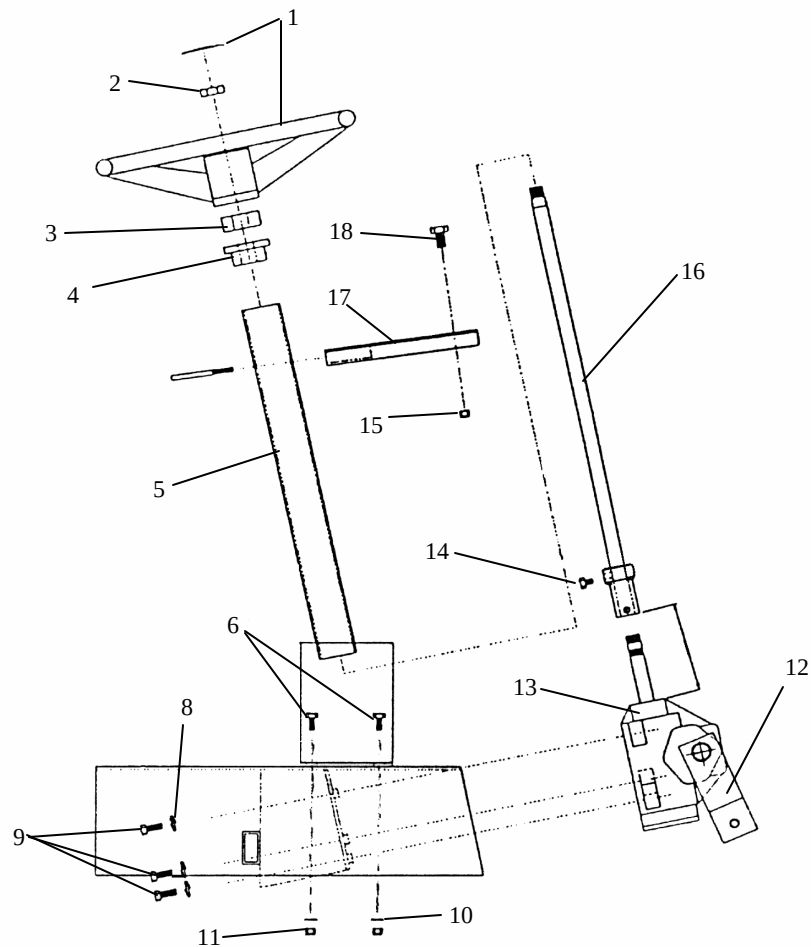
Steering Gear Assembly

Steering Box			
Item	Part #	Description	Qty
1	56805-00	Gear, Steering Assembly (Complete)	1
*		Steering Column (See page 4-21 for detail)	1
2 **	719195	Adjuster, Lockout Worm Bearing	1
3 **	719196	Adjuster, Assembly	1
4 **	719197	Cup, Bearing (Upper & Lower)	2
5 **	719198	Bearing, Cone (Upper & Lower)	2
6 **	N/A	Retainer, Lower Bearing -	1
7 **	N/A	BNSW Assembly	0
8 **	N/A	Nut, Pitman Arm	1
9 **	N/A	Lockwasher 103320	1
10 **	N/A	Seal, Pitman Shaft	1
11 **	N/A	Seal, Worm Shaft	1
12	719188	Gasket, Side Cover	1
13 **	719199	Shaft, Pitman	1
14 **	719200	Adjuster, Lash	1
15 **	719201	Shim, Kit Adjuster Preload	1
16 **	719202	Cover, Side	1
17 **	719203	Bolts, Side Cover	3
18 **	719204	Nut, Preload Adjuster	
* Parts Shown for display only, not sold separately			
** Items show for clarification only, Not sold separately			



Steering Column Assembly

Steering Column			
Item	Part #	Description	Qty
1	56810-00	Wheel, Steering 14", With Cap	1
2	7947-W	Nut 5/8-18	1
3	56874-00	Cover, Dust	1
4	10504	Bushing .75 ID, Plastic	1
5	56811-00	Weldment, Steering Column	1
6	2551-W	Bolt, Carriage 1/4-20 x 1	4
7	56872-00	Steering Mount, Frame Member	1
8	7039	Lockwasher, 7/16	3
9	3769	Screw, 7/16-14 x 11/2, Cap	3
10	6703-B	Washer 1/4	4
11	7742	Locknut, 1/4-20	4
12	56817-00	Pitman Arm	1
13	56805-00	Steering Gear Box	1
14	3987-BS	Screw 5/16 UNC x 3/4"	1
15	56873-00	Collar, Shaft 3/4 x 1 1/4	1
16	7778	Locknut, 3/8-19	2
17	56807-00	Steering Shaft 2 1/2" Long	1
18	56813-00	Support, Steering Column	1
19	2879-W	Screw, Hex Cap 3/8-16 x 1	2

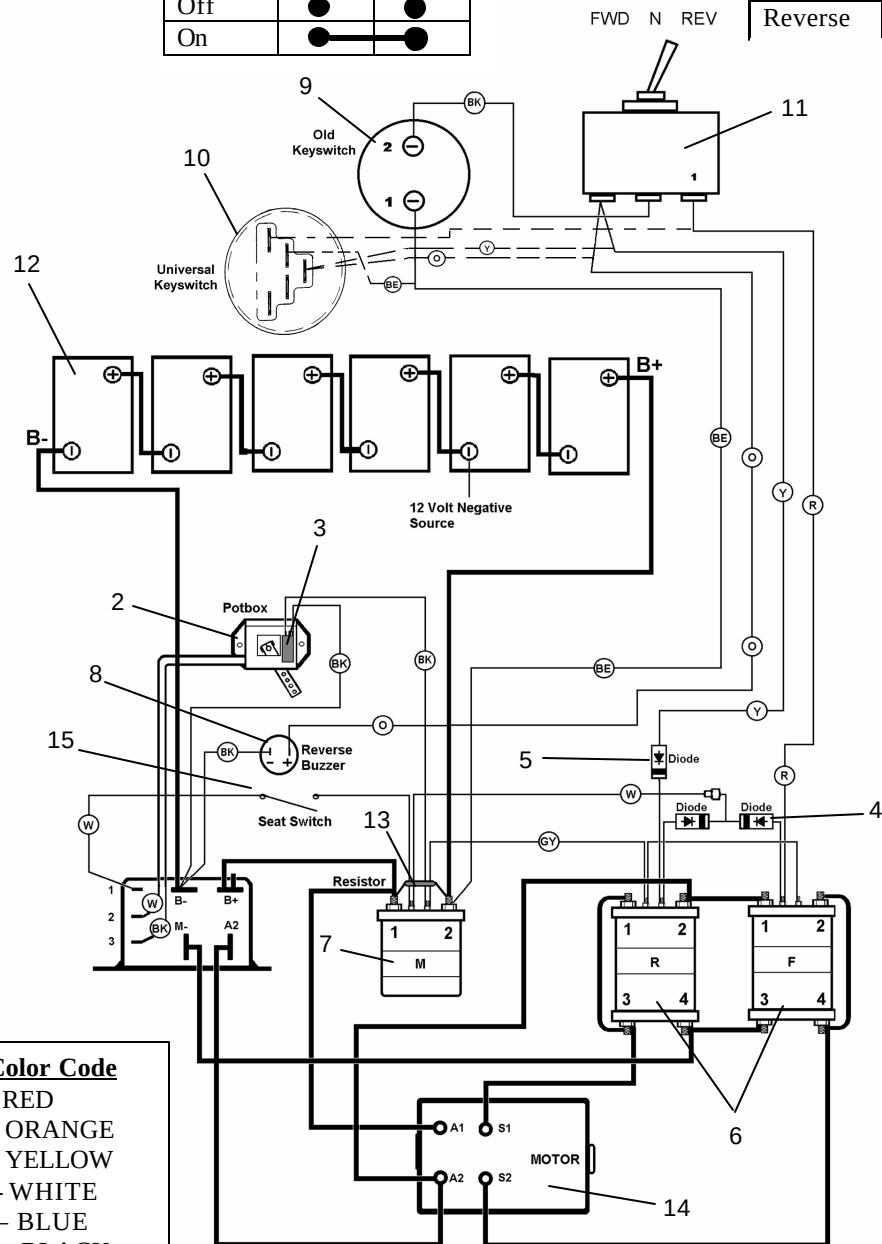


Electrical Wiring – 36 and 48 Volt, XP+ Power System			
Item	Part #	Description	Qty
1	74883-87	Module, Speed Controller (36 Volt)	1
*	74883-87	Module, Speed Controller (48 Volt 275 Amp)	1
		Module, Speed Controller (36Volt 400 Amp)	1
		Module, Speed Controller (36/48 Volt 400 Amp, CMC)	1
		Speed Switch (Pot Box)	1
		Micro Switch	1
		Diode, Set (With Connectors)	1
		Diode (Only)	4
6	71459-87	Solenoid 6T 36 V	2
*	71457-99	Solenoid 6T 48 V	2
7	71458-87	Solenoid 4T 36 V	1
*	71456-99	Solenoid 4T 48 V	1
*	66501-89	Charger, built-in 36V, 25 AMP (115V - 60Hz)	1
*	66545-00	Charger, built-in, 48V (120V - 60Hz)	1
*	66606-00	Charger built-in 36V (W/Plug and Ammeter on panel)	1
*	66035-87	AC Receptacle, Charger - Built-in	1
*	66493-67A	Cord, Extension	1
8	71408-96	Buzzer, Round Reverse (9-48 Volt)	1
*	75052-01	Meter, BDI 36V	1
*	75053-01	Meter, BDI 48V	1
*	69001-76A	Horn, 12 Volt	1
9	69706-00	Key Switch, with Key	1
*	69799-00	Key, Only	1
10	71730-01	Keyswitch, Universal	1
11	69768-00	Switch, Forward / Reverse	1
12	66014-84 **	Battery, 6 Volt, Deep Cycle T105 220Ah	6/8
*	66016-96 **	Battery, 6 Volt, Deep Cycle T-145 244 Ah	6/8
*	66020-00	Battery, 8 Volt	6
13	69723-00	Resistor Assembly	
*	67724-91	Head Light	2
14	69201-96	Motor, Traction 36V	1
*	69401-96	Motor, Traction 48V	1
15	708056	Seat Switch (Integral Part of LH Seat PN 51701-00)	1
*	68020-92	Taillight, Round 4 “	2
*	69705-00	Switch, Light	1
*	69700-00	Block, Fuse	2
*	69717-00	Fuse, 10 Amp	3
*	69702-00	Fuse, 30 Amp	1
*	66324-00	Battery Hold Down	2
*	71807-80	Button, Horn	1
* Not Pictured in Illustration			
** Wet Cell, Sold As Is Only. Pick-up or Will Call ONLY			

Speed Control (cont.)

Old Key Switch Connection		
Position	1	2
Off	●	●
On	●—●	●—●

Electrical Shift Switch Connection			
Position	1	2	3
Forward	●	●—●	●
Neutral	●	●	●
Reverse	●—●	●	●



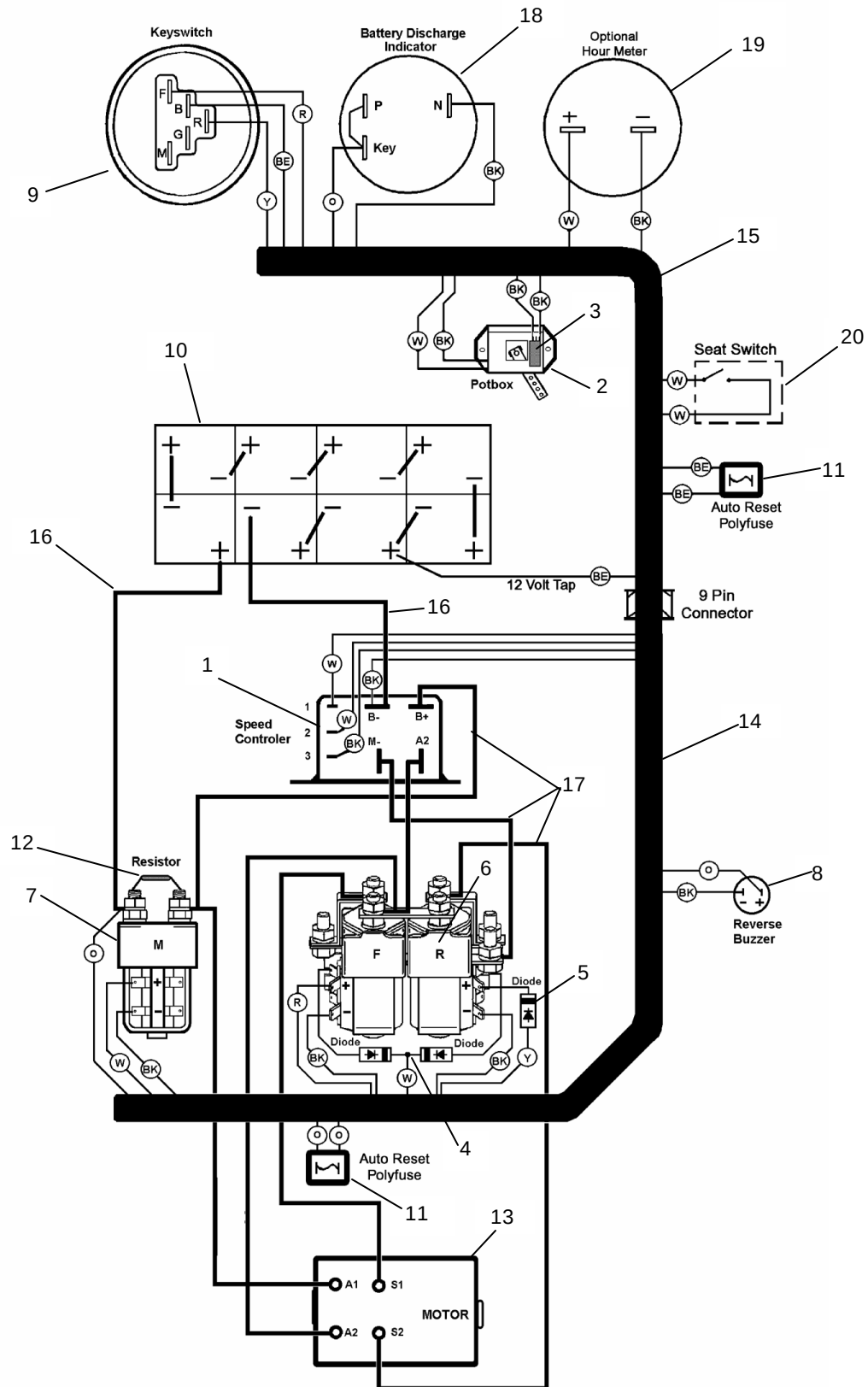
Color Code

R - RED
 O - ORANGE
 Y - YELLOW
 W - WHITE
 BE - BLUE
 BK - BLACK
 GY - GRAY
 All Unspecified
 Cables are Black

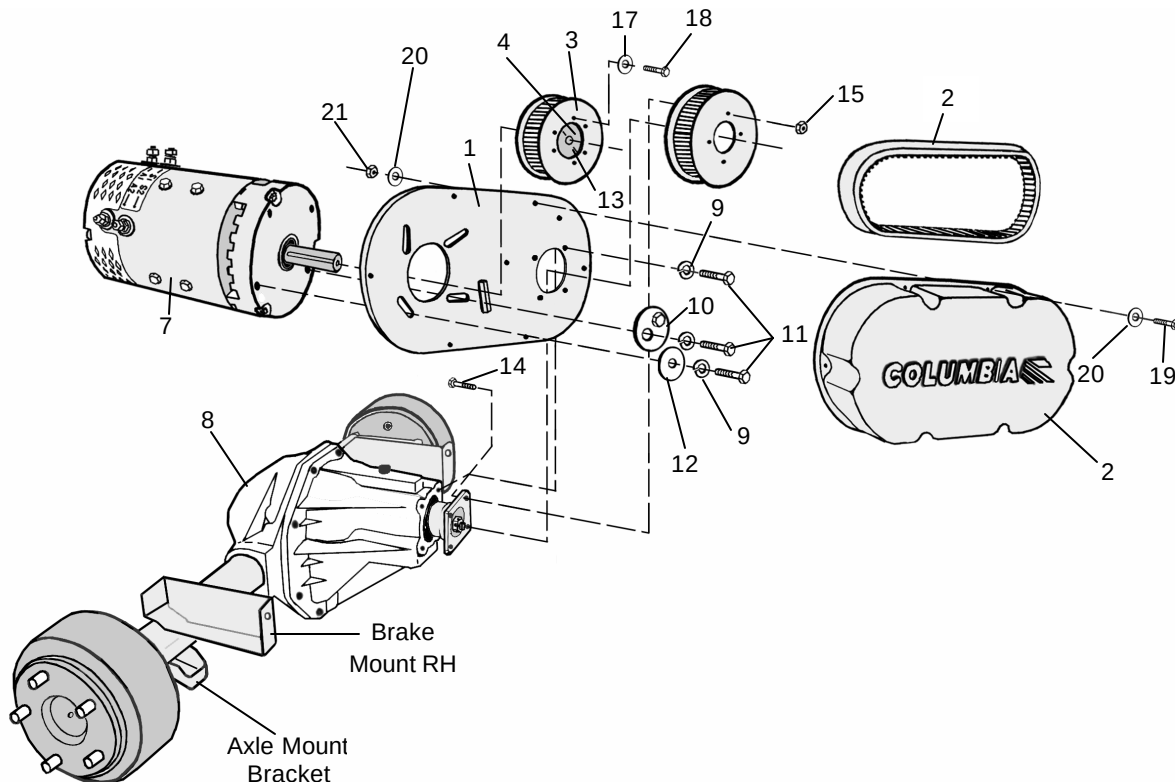
M18 Electrical Wiring BC3-30, BC4-25, BC3-30XB, BC4-25XB

M18 Electrical Wiring BC3-30, BC4-25, BC3-30XB, BC4-25XB			
Item	Part #	Description	Qty
1	74889-99	Module, Speed Controller (36/48V 275 AMP)	1
*	69844-00	Module, Speed Controller (36/48V 400 AMP)(Optional)	1
2	70061-00A	Switch, Speed 9Pot Box)	1
3	78011-97	Switch, Micro	1
4	74886-02	Diode Set (With Connectors)	1
5	74865-02	Diode Only	4
6	69823-00	Solenoid, Double 12V Coil (Forward/Reverse)	1
7	17454-02	Solenoid, Single12V Coil (Main)	1
8	71408-96	Alarm, Reverse (9 - 48V)	1
9	71730-01	Keyswitch, Universal	1
*	71731-01	Keys Only	2
10	66014-84	Battery, Deep Cycle 6V T-105 220Ah	6/8
*	66016-96	Battery, Deep Cycle 6V T-145 244Ah	6/8
*	66020-00	Battery, Deep Cycle 8V	6
11	74596-02	Fuse, Poly Auto Reset	2
12	70592-87	Resistor Assembly	1
13	69401-00	Motor, Traction 36/48V	1
14	70075-02	Harness, Wiring Control Panel	1
15	70076-02	Harness, Wiring Main	1
*	68869-02	Harness, Wiring 12V Accessory	1
16	70105-88	Cable, 4 Gage 37 1/2" Length	2
17	70448-90	Cable, 6 Gage 20" Length	7
18	75053-01	Meter, BDI 48V ENM	1
*	75052-01	Meter, BDI 36V ENM	1
19	75033-91	Meter. Hour (10 - 80 VDC)	1
20	708056	Switch Seat (Located in Seat Cushion Assy 14953-176176)	1
*	71807-80	Button, Horn	1
*	69001-76A	Horn, 12V	1
*	67724-91	Headlight	2
*	68020-92	Taillight, Round (4")	2
*	71426-02	Switch, Turn Signal	1
*	69705-00	Switch, Headlight	1
*	6603-02	Charger, Built-in 36V, 25 AMP (115V - 60Hz)	1
*	66604-02	Charger, Built-in 48V (120V - 60Hz)	1
*	66035-87	Receptacle, AC (Built-in Charger)	1
*	66493-67A	Cord, Extension	1
* Not Pictured in Illustration			

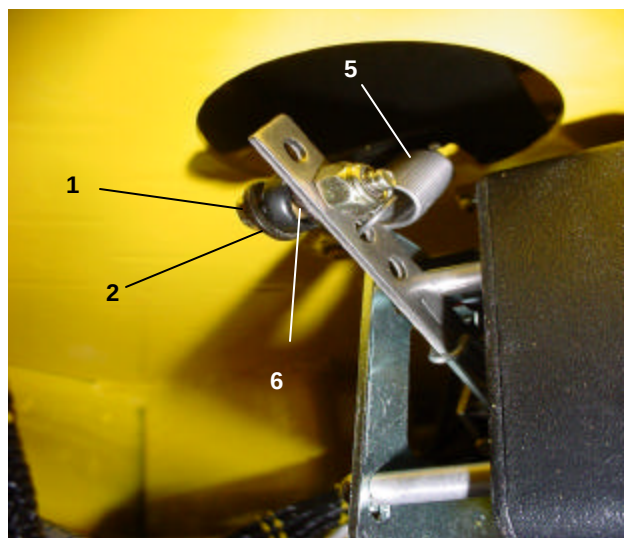
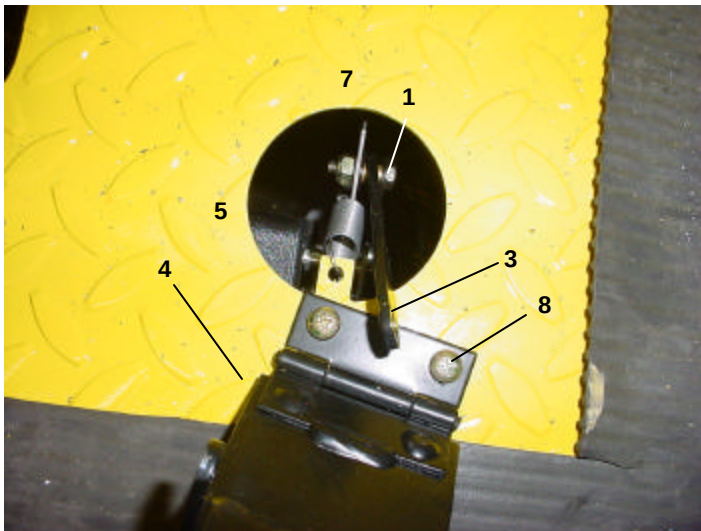
M18 Electrical Wiring BC3-30, BC4-25, BC3-30XB, BC4-25XB



M18 Drive System BC3-30, BC4-25, BC3-30XB, BC4-25XB			
Item	Part #	Description	Qty
1	33480-02	Plate, M18 Motor Mount	1
2	36387-02	Belt, Toothed 960T	1
3	36385-02	Sprocket, Belt 40T	1
4	36384-02	Bushing, 7/8" (For 40T Sprocket)	1
5	33481-02	Cover, M18 Drive	1
6	36386-02	Sprocket, Belt 56T	1
7	69401-00	Motor, Traction 36/48V	1
8	82980-01	Axle, M18 12.25:1	1
*	82853-95	Bracket, Axle	2
*	41265-00	Bracket, Mounting LH Brake	1
*	41266-00	Bracket, Mounting RH Brake	1
9	7038-B	Lockwasher, 3/8	8
10	33420-00	Washer, Chain Adjuster	1
11	4716-W	Screw, Hex Cap 3/8-16x1 1/4"	1
12	6416	Washer, Type A Plain 3/8	3
13	11207	Key, Parallel 3/16 Sqx2"	1
14	4720-B	Screw, Black Zinc 3/8-16x1 3/4"	4
15	7778	Locknut, Nylok 3/8-16	4
16	7538	Locknut, Flange 5/16-18	1
17	7036-B	Washer	3
18	2872-W	Screw, Hex Cap 1/4-20x1 1/2"	3
19	2551-W	Screw, Hex Cap 1/4-20x1" (Cover Mounting)	6
20	6703-B	Washer, Type A 1/4" (Cover Mounting)	6
21	7686	Locknut, Nylok 1/4-20 (Cover Mounting)	6
*	2879-W	Screw, Hex Cap 3/8-16X1" (Plate to Axle)	7
* Not Pictured in Illustration			



Accelerator Linkage



Accelerator			
Item	Part #	Description	Qty
1	2339	Screw, #10-24 x ¾"	2
2	6716	Washer, # 10 Plain Type A	4
3	40308-00	Rod, Connecting (To Pot Box)	1
4	40301-00	Pedal, Accelerator Assembly	1
5	11834	Spring, Extension	1
6	5760	Bushing	2
7	7624	Locknut, Nylok #10-24	2
8	2592	Screw, Pan Head #10-24 x ½"	2

Options

Cargo Retainer				
Item	Part #	Description	Qty	
			STD	XB
*	51380-00	Kit, Cargo Retainer 12"	1	-
	51381-00	Kit, Cargo Retainer 12"	-	1
1	51382-00	Assembly, Side Panel	2	-
	51383-00	Assembly, Side Panel	-	2
2	51384-00	Assembly, End Panel	1	1
3	51373-00	Stake Pocket	8	8
4	3767-B	Bolt 1/4-20 x5/8"	32	32
*	6703-B	Lockwasher, 1/4	32	32
*	7724-B	Nut 1/4-20	32	32
*	51320-00	Deckboard, Short	1	1
*	51321-00	Deckboard, Long	1	1

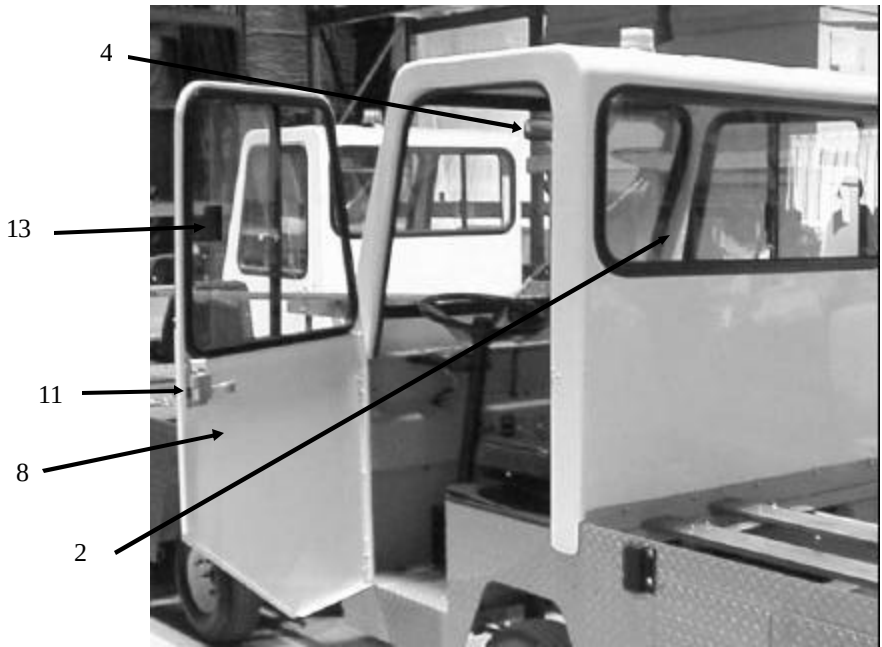
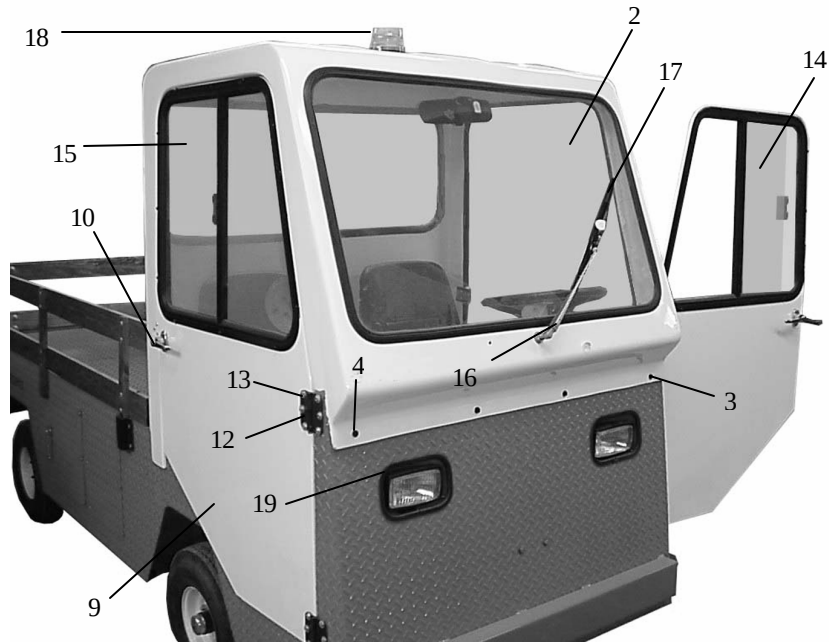
NOTE: Other cargo retainer styles may be available. Contact your local dealer.



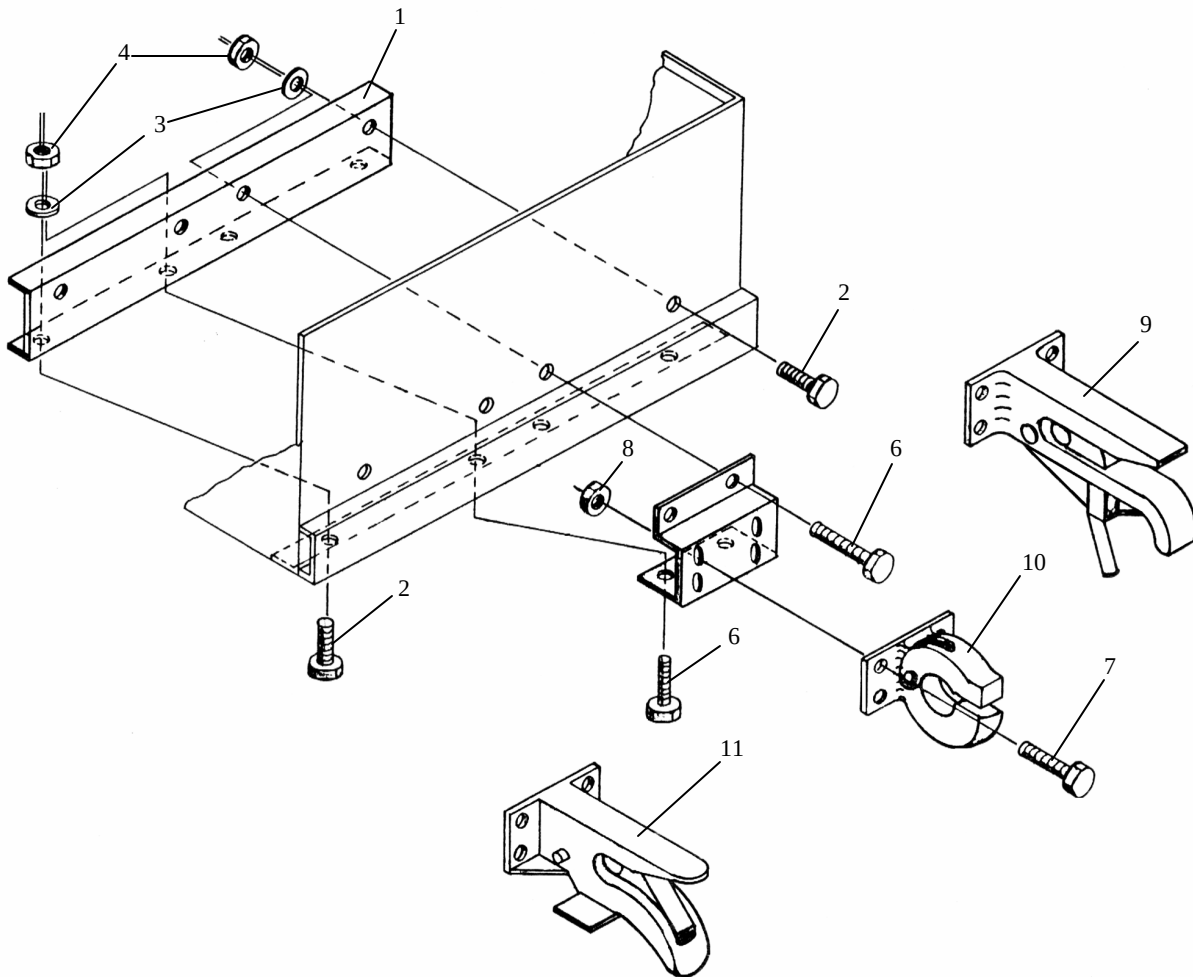
Options (cont.)

Cab Items			
Item	Part #	Description	Qty
1	90122-00	Kit, Cab, Complete Fiberglass (Includes Doors & Wiper)	1
*	90123-00	Cab, Complete w/o Doors	1
*	90129-00	Assembly, Cab Complete (With out Doors, Wiper & Protector Panel)	1
*	90628-00	Steel Cab Kit	1
*	90637-00	Door Kit, Steel Cab	1
*	3787-B	Bolt 1/4-20 x 3/4, Cab Front (Cowl Mounting)	4
*	7036-B	Washer, Flat 1/4, Cab Front (Cowl Mounting)	4
*	7742	Locknut, 1/4-20, Cab Front (Cowl Mounting)	4
2	90118-00	Windshield	1
3	8305	Rivet, Pop Black Oxide Coated (Window Mounting)	14
4	6004	Washer (Window Mounting)	30
5	90117-00	Window, Rear	1
*	48882-ZZ	Trim (Cab Front) (Order by Foot) (Not Shown)	-
*	8305	Rivet, Pop Black Oxide Coated (Window Mounting) (Trim Mounting)	2
6	84120-92	Mirror, Rear View	1
*	2592	Screw, Machine 10-24 x 1/2" (Mirror Mounting)	2
*	7998	Nut (Mirror Mounting)	2
*	90134-00	Panel, Protector (Rear Cab)	1
*	3987-BS	Bolt 5/16-18 x 3/4 (Protector Panel to Cab)	3
*	4017	Bolt 5/16-18 x 1 (Panel to Cab to Frame)	5
*	3252	Washer 5/16, Flat (Panel to Cab to Frame)	8
*	7739	Locknut, 5/16-18, (Panel to Cab to Frame)	8
*	90132-00	Trim, Door Opening, LH	1
*	90133-00	Trim, Door Opening, RH	1
*	8305	Rivet, Black (Window Mounting) Trim Mounting	26
*	6004	Washer (Trim Mounting)	26
7	60046	Weather-strip, Door Opening (Order by Foot)	-
8	90125-00	Assembly, Door Complete LH	1
*	90124-00	Assembly, Door LH (Does not include Latch, Hinges & Window)	1
9	90127-00	Assembly, Door Complete RH	1
*	90126-00	Assembly, Door RH (Does not include Latch, Hinges & Window)	1
10	51355-00	Door, Handle, Outer (non-locking)	2
*	51353-00	Door, Handle, Outer (locking)	2
*	2592	Screw, Machine 10-24 x 1/2"	4
*	7118	Lockwasher, #4	4
11	20933	Door Handle/Latch LH	1
*	20943	Door Handle/Latch RH	1
*	2530	Screw, Inside Door Handle/Latch Mounting	8
*	11742	Nut, Tinnerman (Inside Door Handle/Latch Mounting)	8
12	10653-00	Hinge, Cab Door	4
13	3767-B	Bolt 1/4-20 x 5/8 (Hinge to Door & Hinge to Cowl)	24
*	6031	Washer #10, Flat (Hinge to Door)	12
*	7036-B	Washer 1/4, Flat (Hinge to Cowl)	12
*	7036-B	Lockwasher 1/4, (Hinge to Door & Hinge to Cowl)	24
*	7688-B	Nut, Hex 1/4-20 (Hinge to Door & Hinge to Cowl)	24
14	61266	Assembly, Door Window LH	1
15	61276	Assembly, Door Window RH	1
*	2532	Screw, Sheet Metal (Window Mounting)	24
16	84114-92	Wiper, Arm Adjustable (Option)	1
17	84113-92	Wiper, Blade 18" (Option)	1

Cab Items			
Item	Part #	Description	Qty
*	84111-92	Wiper Motor 2" 12V (Option)	1
*	90131-00	Striker Plate, Cab Door	2
18	74131-00	Kit, Burden Carrier Dome Light	1
*	2602	Screw, Machine 10-24 x 1/4" Plate Mounting	4
*	1005	Screw, Striker Plate Mounting	2
*	7998	Nut, Striker Plate Mounting	6
19	48865-ZZ	Pinch Weld (Around Headlights)(by Foot)	2

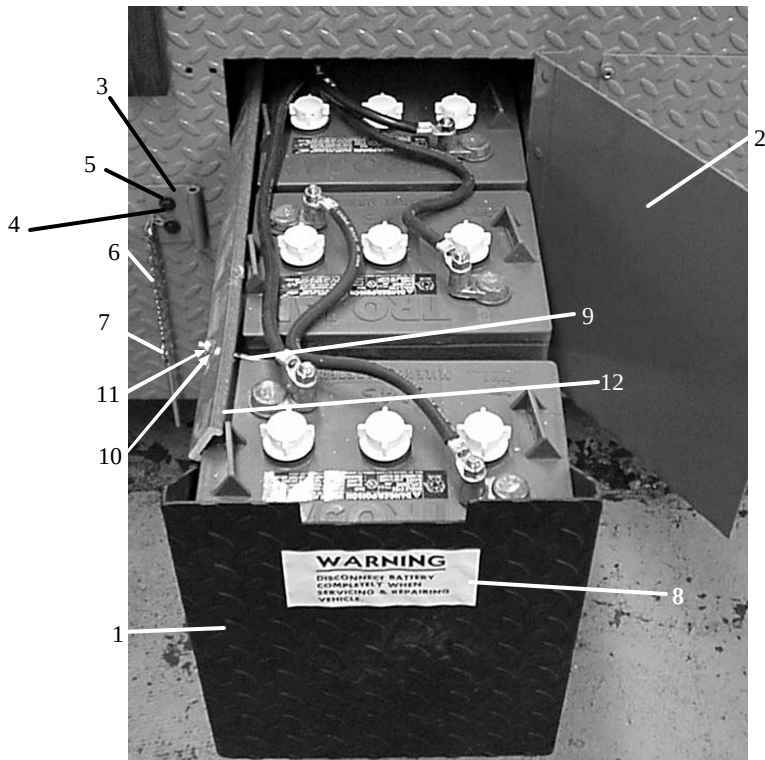


Hitches			
Item	Part #	Description	Qty
	57318-00	Kit, Pintle Hitch	1
1	57307-00	Reinforcing Bracket	1
2	2879-W	Screw, Hex Cap 3/8-16 x 1"	4
3	6000-B	Washer, W-Plain Type A 3/8	16
4	7778	Locknut, Nylok 3/8-16,	8
5	57308-00	Hitch Mounting Bracket	1
6	4716-W	Screw, Hex Cap 3/8-16 x 1 1/4	4
7	4043	Bolt, Hex Hd, Grade 8 1/2-13x1"	4
8	7685	Locknut, Nylok Thin 1/2-13	4
9	14388	Hitch, Automatic Type (To 26,000 lbs.)	1
10	57315-96	Hitch, Pintle Type (Harval #T60AL)(Aerol #82003)	1
11	12598	Hitch, Automatic Type (To 10,000 lbs.)	1



Options (cont.)

Battery Push-Pull Kit				
Item	Part #	Description	Qty	
			STD	XB
	51357-00	Kit, Push-Pull Battery Box	-	1
1	51358-00	Box, Push-Pull	1	1
2	51362-00	Assembly, Door (1 Each Side)	2	2
*	51360-00	Door, Push-Pull (Door Mounting Hardware)	1	1
*	51361-00	Hinge, Push-Pull (Door Mounting Hardware)	1	1
*	8211	Rivet (Body to Door Mounting Hardware)	2	2
*	3787-B	Bolt (Body to Door Mounting Hardware)	4	4
*	7036-B	Washer (Body to Door Mounting Hardware)	4	4
*	7688-B	Nut (Body to Door Mounting Hardware)	4	4
3	51636-00	Latch, Door	2	2
*	3787-B	Bolt (Latch to Body Mounting Hardware)	4	4
*	2551-W	Bolt (Chain to Latch to Body Mounting Hardware)	2	2
*	6031	Washer (Chain to Latch to Body Mounting Hardware)	2	2
*	7036-B	Washer (Latch to Body Mounting Hardware)	4	4
*	7688-B	Nut (Latch to Body Mounting Hardware)	6	6
4	45456-ZZ	Chain (15 Links)	2	2
5	314	Assembly, Latch Pin for Push-Pull Kits	2	2
6	60824	Decal "WARNING Disconnect Batteries"	4	4
7	66561-90	Rod 5/16-18, Battery Hold-Down	2	2
8	3252	Washer 5/16, Flat, Battery Hold-Down Mounting Hardware	2	2
9	7680	Locknut, 5/16-18, Battery Hold-Down Mounting Hardware	2	2
10	66605-00	Retainer, Fiberglass Battery Mounting Hardware	1	1
*	9090	Roller, 11 1/4"	4	4
*	6005	Washer / Spacer Cut 1/2	8	8
*	66605-00	Wire Protector	1	1



CHAPTER 5

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Forward & Reverse 36/48-Volt Electric Troubleshooting Guide Appendix E

TROUBLESHOOTING GUIDE	
Vehicle Reaction	Check or Replace
Vehicle will not move	Turn on Key Switch
	Put Toggle Switch in Direction
Key Switch Is on and Toggle Switch is in Direction, Vehicle will Not Move Either Forward or Reverse	Key Switch
	Toggle Switch
	Check Wire Connection
	Speed Control Unit
Vehicle Will Move Only Forward	Check Wire Connections
	Toggle Switch
	Forward Solenoid
Vehicle Will Move Only Reverse	Check Wire Connections
	Toggle Switch
	Reverse Solenoid
If these test procedures do not resolve your vehicle problem, contact your Columbia Industrial Vehicle Dealer for service.	

See page 5-9 for Electrical Schematic Diagram.

XP Plus System (Curtis System)

Operation

The XP Plus speed control system offers infinitely variable speed control, in forward and in reverse. This is a highly efficient speed control system in that the pulse-modulating controller does not waste battery energy. For reduced speeds, the controller turns on and off the motor circuit at an extremely high rate of speed. For increased speed, the controller increases the duration at which the motor circuit is completed, then decreases the connection duration for lower vehicle speed. The result is a smooth and gradual increase and decrease in speed, appropriate to accelerator position. This system also uses a potentiometer (pot box) for accelerator speed control. Two six (6) terminal solenoids are used for directional control, one four (4) terminal solenoid is used as a main contactor.

Speed Control Switch (Pot Box)

For details regarding speed control (pot box) adjustment or repair, refer to page 5-14. This section contains information regarding testing and failure diagnosis.

Warning: Raise vehicle per lifting instructions, Chapter 2. Support safely on jack stands before proceeding. Failure to do so could cause accident and/or injury.

Electrical Operation and Circuits

Charging

Keep switch position.....	Off
Accelerator/speed switch position....	Up/At rest
Solenoid F.....	Not energized connection between bottom terminals; top terminals open
Solenoid R.....	Not energized connection between bottom terminals; top terminals open
Solenoid M.....	Not energized; large terminals open
Controller #1 tab terminal.....	Not energized

Forward Operation

Key switch position forward.....	Accelerator pedal depressed
Solenoid F.....	Energized connection between large top terminals; large bottom terminals open.
Solenoid R.....	Not energized; contact between large bottom terminals; large terminals open
Solenoid M.....	Energized; contact between large top terminals
Controller #1 tab terminal.....	Energized

Reverse Operation

Key switch position reverse	Accelerator pedal depressed
Solenoid F.....	Not energized; contact between large bottom terminals; large top terminals open
Solenoid R.....	Energized connection between large top terminals; large bottom terminals open
Solenoid M.....	Energized; contact between large terminals
Controller #1 tab terminal.....	Energized

Trouble Shooting Guide - XP Plus Speed Control System

Note: Always follow trouble shooting guide in exact order as listed below. Performing tests out of sequence will cause inaccurate results and lost time in diagnosing electrical system problems.

Note: If vehicle equipped with Keyswitch and Forward & Reverse switch turn key on then place switch in desired position forward or reverse.

Vehicle Does Not Operate, Forward or Reverse.		
Test	Passed	Failed
Voltmeter positive red lead to battery B+ terminal, Voltmeter negative black lead to battery B- terminal.	Full battery voltage = Good	Less than full battery voltage, charge and or replace batteries.
1. Key switch in forward. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal. 2. Key switch in reverse, Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal.	Full battery voltage = Good	Less than full battery voltage, check key switch and wire harness.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to gray wire at forward solenoid small terminal.	Full battery voltage = Good	Less than full battery voltage, accelerator micro switch or micro switch circuit defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to gray wire at reverse solenoid small terminal..	No Voltage = Good	Full battery voltage, diodes between forward and reverse solenoid defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at main solenoid, Voltmeter negative black lead to gray wire at main solenoid.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids defective, or accelerator micro switch defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at #1 tab terminal of speed control module, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids, or accelerator micro switch defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead gray wire at reverse solenoid small terminal.	Full battery voltage = Good	Less than full battery voltage, accelerator micro switch or micro switch circuit defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to gray wire at forward solenoid small terminal.	No Voltage = Good	Full battery voltage, diodes between forward and reverse solenoids are defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to white wire at main solenoid, Voltmeter negative black lead to gray wire at main solenoid.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids defective, or accelerator micro switch defective.
Key switch in forward, do not depress accelerator pedal. Voltmeter positive red lead to main solenoid #2 terminal, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, low batteries, poor or corroded connections.
Key switch in forward, do not depress accelerator pedal.	1 to 5 volts less	No voltage, defective resistor.

Vehicle Does Not Operate, Forward or Reverse.		
Test	Passed	Failed
Voltmeter positive red lead to main solenoid #1 terminal, Voltmeter negative black lead to controller B- terminal.	than full battery voltage = Good	If full battery voltage, replace welded main solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to main solenoid #1 terminal, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	No increase or voltage drops, replace defective main solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to traction motor A-1 terminal, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, check for loose or poor connections from main solenoid #1 terminal, to controller B+ and to motor A-1.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to controller M- terminal.	As accelerator is depressed, battery voltage should rise to within 1 to 2 volts of battery voltage.	Refer to speed switch testing below before continuing. If speed switch testing concludes speed switch is good, then controller has failed.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #1 terminal at forward solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from controller M - to forward solenoid #1 terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #2 terminal at forward solenoid.	Full battery voltage = Good	If low or no voltage, replace defective forward solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to traction motor S-2 terminal.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from forward solenoid #2 terminal, to forward #3 and to motor S-2.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Volt meter negative black lead to traction motor S-1 terminal.	Full battery voltage = Good	Defective field coil in traction motor. See Traction Motor, page 3-7 for repair procedures.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #3 terminal of reverse solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from motor S-2 terminal, to reverse solenoid #3 terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #4 terminal of reverse solenoid.	Full battery voltage = Good	Less than full battery voltage, replace defective reverse solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to traction motor A-2 terminal.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from reverse solenoid #4 terminal, to forward #3 and to motor A-2.

Vehicle Does Not Operate, Forward or Reverse.		
Test	Passed	Failed
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to A-1 terminal at traction motor, Voltmeter negative black lead to A-2 terminal at traction motor.	Full battery voltage = Good	If motor does not operate, check motor brushes and armature. See Traction Motor, page 3-7.

Speed Switch (Pot Box) Testing		
Test	Passed	Failed
Remove white and black lead wires from controller #2 and #3 1/4" tab terminals. Switch volt/ohm meter to ohms scale. Capable of measuring 0 to 100 ohms. Connect volt/ohm meter leads to white and black wires from controller. Do not depress accelerator. Leave key in off position.	0 to 50 ohms resistance = Good	Greater than 50 ohms, refer to Pot Switch Adjustment, page 5-12. If adjustment does not correct, replace pot switch or speed switch assembly. See page 5-11.
Leave ohmmeter leads connected to white and black leads (removed from controller #2 and #3 tab terminals). Switch ohmmeter to a scale capable of measuring up to 6,000 ohms (K ohms). Slowly depress accelerator and monitor change.	Ohms of resistance should rise gradually to a maximum of 4,500 to 5,500 ohms.	* If rise in resistance is erratic or skips as pedal is depressed, replace pot switch or speed switch assembly. * If maximum resistance is less than or greater than 4,500 to 5,500 ohms, adjust pot switch to correct. Refer to page 5-12.

Note: Always follow trouble shooting guide in exact order as listed below. Performing tests out of sequence will cause inaccurate results and lost time in diagnosing electrical system problems.

Vehicle Does Not Operate In Forward, Operates Correctly in Reverse		
Test	Passed	Failed
Voltmeter positive red lead to battery B+ terminal, Voltmeter negative black lead to battery B- terminal.	Full battery voltage = Good	Less than full battery voltage, charge and or replace batteries.
1. Key switch in forward. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal. 2. Key switch in reverse, Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal.	Full battery voltage = Good	Less than full battery voltage, check key switch and wire harness.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to gray wire at forward solenoid small terminal.	Full battery voltage = Good	Less than full battery voltage, accelerator micro switch or micro switch circuit defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to gray wire at reverse solenoid small terminal..	No Voltage = Good	Full battery voltage, diodes between forward and reverse solenoid defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at main solenoid, Voltmeter negative black lead to gray wire at main solenoid.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids defective, or

Vehicle Does Not Operate In Forward, Operates Correctly in Reverse		
Test	Passed	Failed
		accelerator micro switch defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at #1 tab terminal of speed control module, Voltmeter negative black lead to controller B-terminal.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids, or accelerator micro switch defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal. Voltmeter negative black lead to #1 terminal at forward solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from controller M - to forward solenoid #1 terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #2 terminal at forward solenoid.	Full battery voltage = Good	If low or no voltage, replace defective forward solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #3 terminal of reverse solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from motor S-2 terminal, to reverse solenoid #3 terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #4 terminal of reverse solenoid.	Full battery voltage = Good	Less than full battery voltage, replace defective reverse solenoid.

Note: Always follow trouble shooting guide in exact order as listed below. Performing tests out of sequence will cause inaccurate results and lost time in diagnosing electrical system problems.

Vehicle Does Not Operate In Reverse, Operates Correctly In Forward		
Test	Passed	Failed
Voltmeter positive red lead to battery B+ terminal, Voltmeter negative black lead to battery B- terminal.	Full battery voltage = Good	Less than full battery voltage, charge and or replace batteries.
1. Key switch in forward. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal. 2. Key switch in reverse. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal.	Full battery voltage = Good	Less than full battery voltage, check key switch and wire harness.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to gray wire at forward solenoid small terminal.	Full battery voltage = Good	Less than full battery voltage, accelerator micro switch or micro switch circuit defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to gray wire at forward solenoid small terminal.	No Voltage = Good	Full battery voltage, diodes between forward and reverse solenoid defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to white wire at main solenoid, Voltmeter negative black lead to gray wire at main solenoid.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids defective or accelerator micro switch defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to white wire at #1 tab terminal of speed	Full battery voltage = Good	Less than full battery voltage, diodes between forward and

Vehicle Does Not Operate In Reverse, Operates Correctly In Forward		
Test	Passed	Failed
control module, Voltmeter negative black lead to controller B-terminal.		reverse solenoids, or accelerator micro switch defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal. Voltmeter negative black lead to #2 terminal at reverse solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from controller M - to forward solenoid #2 terminal.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #1 terminal at reverse solenoid.	Full battery voltage = Good	If low or no voltage, replace defective forward solenoid.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to traction motor S-1 terminal.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from reverse solenoid #1 terminal, to reverse #3 and to motor S-1.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #4 terminal of forward solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from motor S-2 terminal, to forward solenoid #4 terminal.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to #3 terminal of forward solenoid.	Full battery voltage = Good	Less than full battery voltage, replace defective forward solenoid.

MOTOR & CONTROL DIAGNOSTICS DIAGRAM

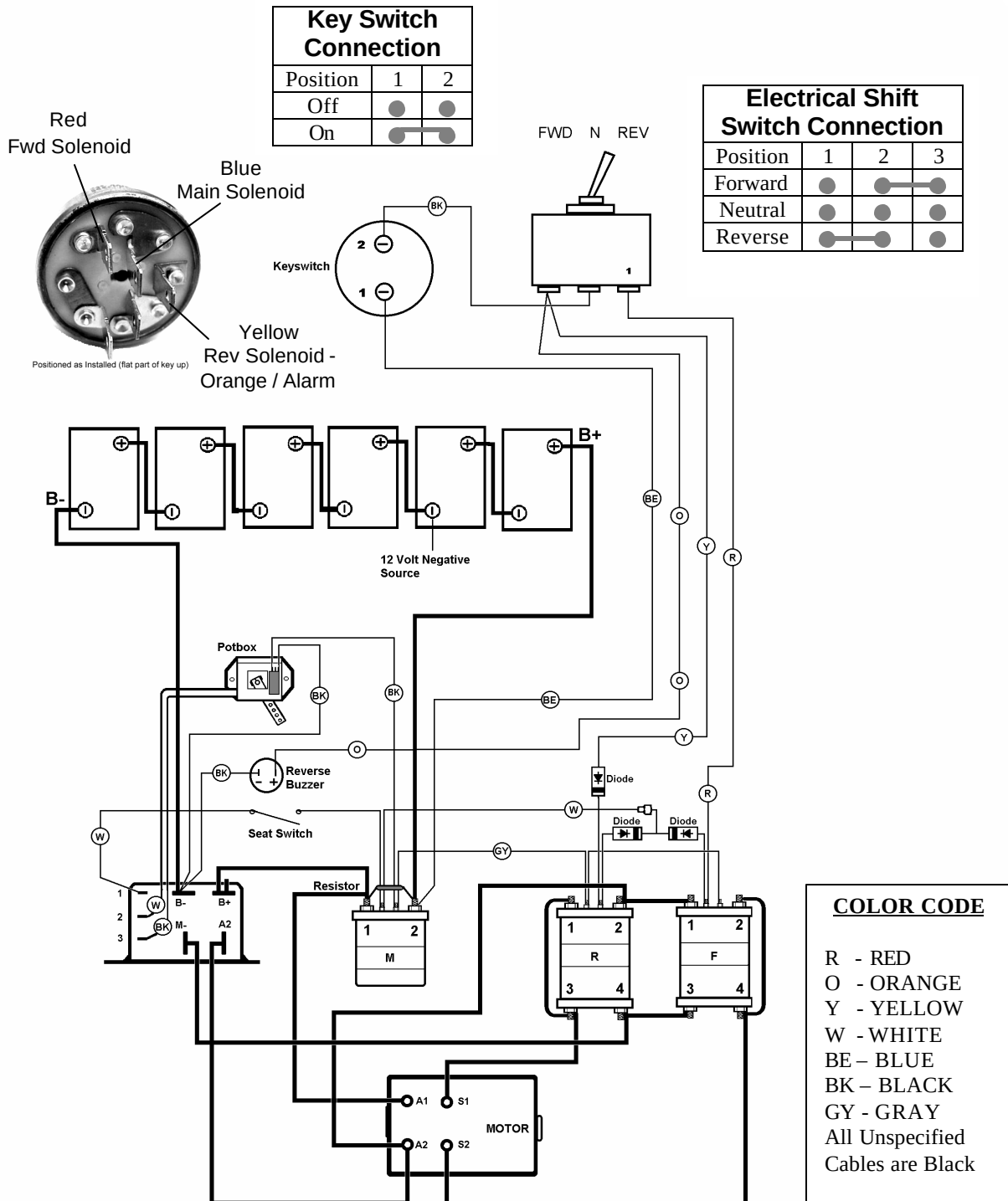


Figure 1 – Wiring Diagram

Speed Switch Assembly

This type of speed switch assembly is used with XP plus system, to signal the speed control module regarding accelerator pedal position.

The speed switch assembly consists of two separate circuits. First is the accelerated micro switch. This switch activates the vehicles electrical system as the accelerator is depressed. As the accelerated is released, this switch disables the vehicles electrical system, for safety and to conserve energy.

The second circuit is a variable resistor, commonly referred to as a "pot" or potentiometer. The potentiometer is a variable resistor used to signal the speed control module regarding accelerated pedal position.

Testing

Testing can be performed on or off of vehicle. To determine if speed switch is functioning correctly, follow precisely testing instructions in the order as they appear. As discussed before, the speed switch assembly uses two separate circuits. Test each circuit to ensure that both components are in proper working order.

Micro Switch Test

1. Using a digital volt/ohm meter (VOM), set to test continuity, probe to the first and third terminals on micro switch.
2. With micro switch lever depressed, no continuity should be observed.
3. With micro switch lever released, continuity should be observed.
4. If results of your test are erratic or inconsistent with the above, the micro switch must be replaced.

Pot Switch Test

1. Using a digital volt/ohm meter (set to test continuity) probe to the terminals at ends of black and white lead wires.
2. With speed switch lever released, 0 to 50 ohms will be observed.
3. With speed switch lever depressed completely, 4500 to 5500 ohms will be observed.
4. As speed switch lever is depressed, resistance should rise smoothly from 0 to 50 ohms, to a maximum of 4500 to 5500 ohms.
5. If resistance value observed is incorrect, refer to Pot Switch Adjustment, page 5-12.



CAUTION: If resistance readings are erratic and inconsistent, the pot switch must be replaced.

Removal

1. Remove red and black wires from micro switch mounted to speed switch.
2. Remove white and black leads from speed control module #2 and # 3 tab terminals.
3. Remove wire ties securing speed switch lead wires to frame.

4. Remove cotter pin and accelerator clevis from speed switch lever. Note which position clevis pin was removed from. You will need to reinstall to original position.
5. Remove screws securing speed switch to frame. Remove speed switch from vehicle.

Disassembly

Note: Refer to Figure 2.

1. Remove two screws (Figure 2, #11) holding micro switch plate to support spacers.
2. Loosen lock screw clamping speed switch lever to pot switch. Remove speed switch lever and return spring.
3. Remove four screws, and remove pot box cover.
4. Remove micro switch plate support spacers from cover.
5. Remove nut holding pot switch into cover, and remove pot switch. See Figure 2 #2)

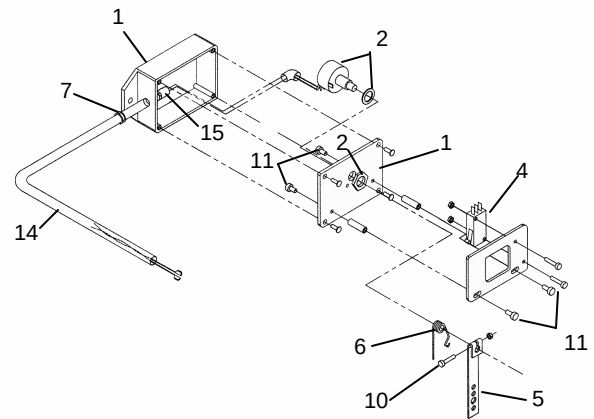


Figure 2 Speed Switch



CAUTION: If pot switch is to be removed, solder connections must be cut or solder must be melted with soldering iron for wire removal. Care must be taken to prevent internal pot switch damage caused by excessive heat when de-soldering and soldering.

6. Lead wires and grommet can now be removed from box.

Assembly

1. Insert lead wires into box with grommet. Check that wire length in box is sufficient for connecting pot switch.
2. Connect black wire to center tab and white wire to left tabs of pot switch. Solder pot switch wires to pot switch tabs. See Figure 3

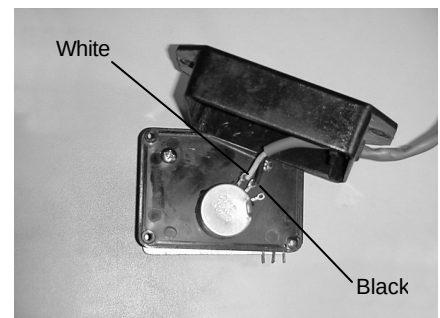


Figure 3 Pot Switch Wires



CAUTION: Care must be taken to prevent internal pot switch damage caused by excessive heat when soldering.

3. Install lock washer onto pot switch, insert pot switch into box cover aligning tab on pot switch to engage into hole in cover. Install nut to outside of box.
4. Install spacers (2) to outside of pot box cover.
5. Install cover with pot switch to box.
6. Install return spring and speed switch lever to pot switch. See Figure 2. Do not torque clamp screw until adjustment has been completed.
7. Install micro switch plate to spacers on switch assembly cover.
8. Refer to Pot Switch Adjustment for final internal adjustment recommendations before use.



WARNING: Any time that a pot switch is disassembled, it must be adjusted before put into use. Failure to perform this adjustment could cause accident or injury.

Pot Switch Adjustment

To adjust pot switch:

1. Loosen screw clamping speed switch lever to pot switch.
2. With volt/ohm meter, connect black and white lead wires (wires must be disconnected from speed control module for this test).
3. With speed switch lever released, rotate pot switch (using a straight screwdriver) until correct reading of 0 to 50 ohms is observed.
4. Torque speed switch lever clamp screw and rotate speed switch lever to full speed position. Check for 4500 to 5500 ohms. Adjust pot switch as required only if necessary to achieve correct ohm resistance value.



CAUTION: If resistance results are inconsistent or erratic, the pot switch must be replaced.

Installation

1. Set speed switch into place on frame mount, and install speed switch mount screws. Do not torque screws at this time.
2. Connect accelerator linkage using clevis pin, washer and new cotter pin.



CAUTION: As linkage is connected, check that accelerator rod moves freely without interference with frame or other components. Tension from interference will damage switch over time and cause pot switch failure.

3. Adjust accelerated switch position (if mount holes are slotted) and torque mounting screws.
4. Route wires along frame to speed control module. Connect white lead wire to # 2 tab terminal and black lead wire to # 3 tab terminal on speed control module. See Figure 3.
5. Tie speed switch wires along frame with wire ties, to prevent wires from dragging under vehicle and damaging wires.
6. Connect red and black wires from wire harness to speed switch assembly micro switch, 1st and 3rd terminals. DO NOT USE CENTER TERMINAL.

Speed Switch Assembly Adjustment

Slowly depress accelerator, and check that:

1. As accelerator is depressed, speed switch lever does not contact micro switch plate support spacers.
2. As accelerator is released, speed switch lever must contact micro switch lever shortly before accelerator pedal reaches stop position. Also, check at speed switch lever does not contact micro switch support spacer.

If adjustment is required, remove clevis pin from speed switch lever and rotate clevis to lengthen or shorten accelerator rod as required.



CAUTION: All years and models of vehicles will not be the same regarding the clevis pin position in speed switch arm. If clevis pin is inserted into incorrect speed switch lever hole, the following will occur:

- * Vehicle will not operate at full speed or poor hill climbing performance will be observed. Move clevis pin down one hole on speed switch lever.
- * Speed switch lever will contact micro switch plate support spacers, and rod adjustment will not correct the problem. Move clevis pin up one hole on speed switch lever.

Always, use new cotter pin when reassembling.

M-18 Speed Control System

Operation

The M-18 speed control system offers infinitely variable speed control, in forward and in reverse. This is a highly efficient speed control system in that the pulse-modulating controller does not waste battery energy. For reduced speeds, the controller turns on and off the motor circuit at an extremely high rate of speed. For increased speed, the controller increases the duration at which the motor circuit is completed, then decreases the connection duration for lower vehicle speed. The result is a smooth and gradual increase and decrease in speed, appropriate to accelerator position. This system also uses a potentiometer (pot box) for accelerator speed control. Two six (6) terminal solenoids are used for directional control, one four (4) terminal solenoid is used as a main contactor.

Speed Control Switch (Pot Box)

For details regarding speed control (pot box) adjustment or repair, refer to page 5-10. This section contains information regarding testing and failure diagnosis.

Warning: Raise vehicle per lifting instructions, Chapter 2. Support safely on jack stands before proceeding. Failure to do so could cause accident and/or injury.

Electrical Operation and Circuits

Charging

Keep switch position.....	Off
Accelerator/speed switch position....	Up/At rest
Solenoid F.....	Not energized connection between bottom terminals; top terminals open
Solenoid R.....	Not energized connection between bottom terminals; top terminals open
Solenoid M.....	Not energized; large terminals open
Controller #1 tab terminal.....	Not energized

Forward Operation

Key switch position forward.....	Accelerator pedal depressed
Solenoid F.....	Energized connection between large top terminals; large bottom terminals open.
Solenoid R.....	Not energized; contact between large bottom terminals; large terminals open
Solenoid M.....	Energized; contact between large top terminals
Controller #1 tab terminal.....	Energized

Reverse Operation

Key switch position reverse	Accelerator pedal depressed
Solenoid F.....	Not energized; contact between large bottom terminals; large top terminals open
Solenoid R.....	Energized connection between large top terminals; large bottom terminals open
Solenoid M.....	Energized; contact between large terminals
Controller #1 tab terminal.....	Energized

Trouble Shooting Guide M-18 Speed Control System

Note: Always follow trouble shooting guide in exact order as listed below. Performing tests out of sequence will cause inaccurate results and lost time in diagnosing electrical system problems.

Note: If vehicle equipped with Keyswitch and Forward & Reverse switch turn key on then place switch in desired position forward or reverse.

Vehicle Does Not Operate, Forward or Reverse.		
Test	Passed	Failed
Voltmeter positive red lead to battery B+ terminal, Voltmeter negative black lead to battery B- terminal.	Full battery voltage = Good	Less than full battery voltage, charge and or replace batteries.
1. Key switch in forward. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal. 2. Key switch in reverse, Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal.	Full battery voltage = Good	Less than full battery voltage, check key switch and wire harness.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to black wire at forward solenoid small terminal.	Full battery voltage = Good	Less than full battery voltage, accelerator micro switch or micro switch circuit defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to black wire at reverse solenoid small terminal..	No Voltage = Good	Full battery voltage, diodes between forward and reverse solenoid defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at main solenoid, Voltmeter negative black lead to black wire at main solenoid.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids defective, or accelerator micro switch defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at #1 tab terminal of speed control module, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids, or accelerator micro switch defective or charger interlock.
Key switch in forward, do not depress accelerator pedal. Voltmeter positive red lead to main solenoid #2 terminal, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, low batteries, poor or corroded connections.
Key switch in forward, do not depress accelerator pedal. Voltmeter positive red lead to main solenoid #1 terminal, Voltmeter negative black lead to controller B- terminal.	1 to 5 volts less than full battery voltage = Good	No voltage, defective resistor. If full battery voltage, replace welded main solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to main solenoid #1 terminal, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	No increase or voltage drops, replace defective main solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to traction motor A-1 terminal, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, check for loose or poor connections from main solenoid #1 terminal, to controller B+ and to motor A-1.

Vehicle Does Not Operate, Forward or Reverse.		
Test	Passed	Failed
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to controller M- terminal.	As accelerator is depressed, battery voltage should rise to within 1 to 2 volts of battery voltage.	Refer to speed switch testing below before continuing. If speed switch testing concludes speed switch is good, then controller has failed.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to large side terminal at reverse solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from controller M - to reverse solenoid large side terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to S2 terminal at traction motor.	Full battery voltage = Good	If low or no voltage, replace defective reverse solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to traction motor S-1 terminal.	Full battery voltage = Good	Defective field coil in traction motor. See Traction Motor, page 3-7 for repair procedures.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to bottom terminal of forward solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from motor S-2 terminal, to forward solenoid bottom terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to top terminal of forward solenoid.	Full battery voltage = Good	Less than full battery voltage, replace defective forward solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to traction motor A-2 terminal.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from forward solenoid top terminal and to motor A-2.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to A-1 terminal at traction motor, Voltmeter negative black lead to A-2 terminal at traction motor.	Full battery voltage = Good	If motor does not operate, check motor brushes and armature. See Traction Motor, page 3-7.

Speed Switch (Pot Box) Testing		
Test	Passed	Failed
Remove white and black lead wires from controller #2 and #3 1/4" tab terminals. Switch volt/ohm meter to ohms scale. Capable of measuring 0 to 100 ohms. Connect volt/ohm meter leads to white and black wires from controller. Do not depress accelerator. Leave key in off position.	0 to 50 ohms resistance = Good	Greater than 50 ohms, refer to Pot Switch Adjustment, page 5-12. If adjustment does not correct, replace pot switch or speed switch assembly. See page 5-11.
Leave ohmmeter leads connected to white and black leads (removed from controller #2 and #3 tab terminals). Switch ohmmeter to a scale capable of measuring up to 6,000 ohms (K ohms). Slowly depress accelerator and monitor change.	Ohms of resistance should rise gradually to a maximum of 4,500 to 5,500 ohms.	* If rise in resistance is erratic or skips as pedal is depressed, replace pot switch or speed switch assembly. * If maximum resistance is less than or greater than 4,500 to 5,500 ohms, adjust pot switch to correct. Refer to page 5-12.

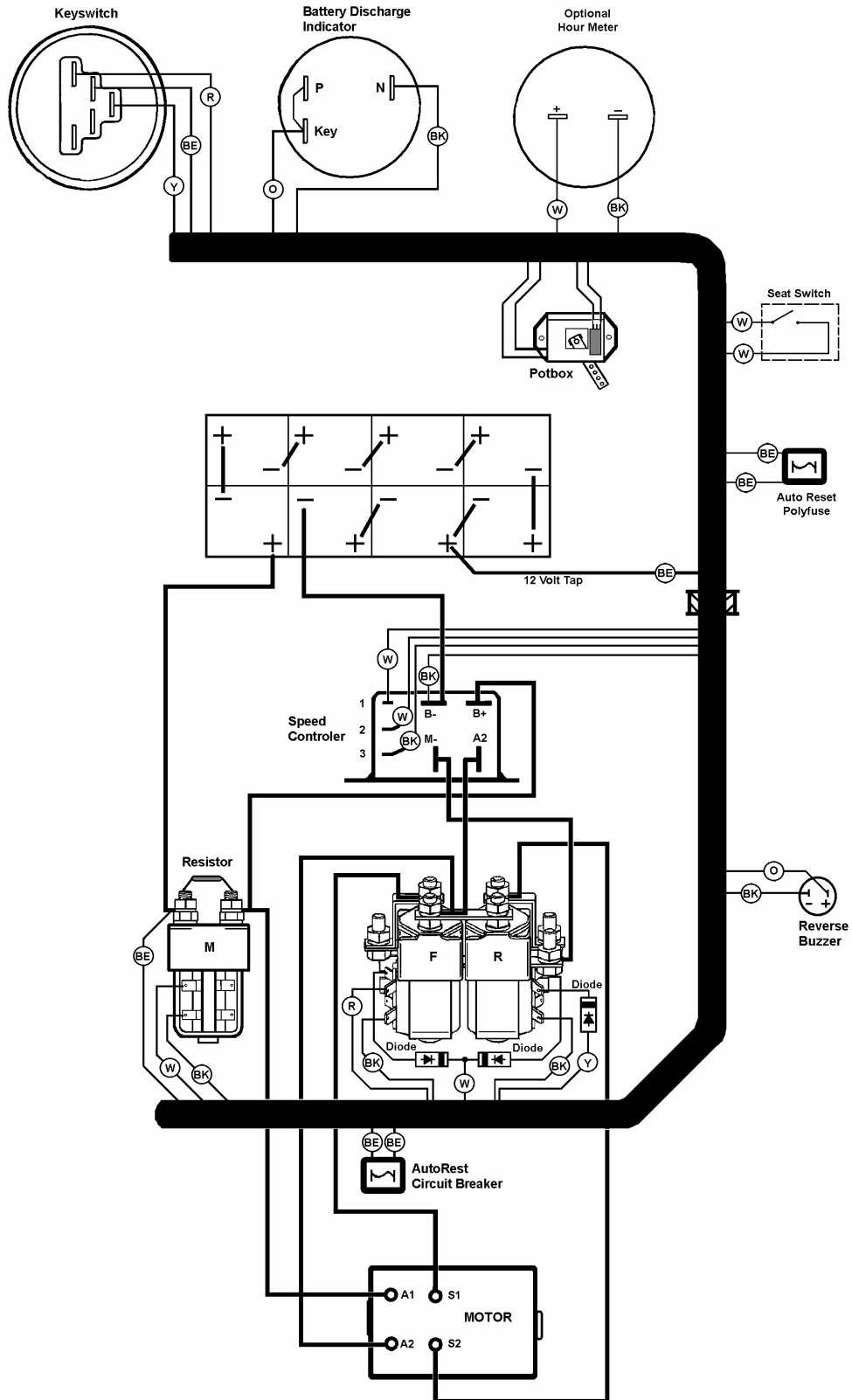
Note: Always follow trouble shooting guide in exact order as listed below. Performing tests out of sequence will cause inaccurate results and lost time in diagnosing electrical system problems.

Vehicle Does Not Operate In Forward, Operates Correctly in Reverse		
Test	Passed	Failed
Voltmeter positive red lead to battery B+ terminal, Voltmeter negative black lead to battery B- terminal.	Full battery voltage = Good	Less than full battery voltage, charge and or replace batteries.
1. Key switch in forward. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal. 2. Key switch in reverse, Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal.	Full battery voltage = Good	Less than full battery voltage, check key switch and wire harness.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to black wire at forward solenoid small terminal.	Full battery voltage = Good	Less than full battery voltage, accelerator micro switch or micro switch circuit defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to black wire at reverse solenoid small terminal..	No Voltage = Good	Full battery voltage, diodes between forward and reverse solenoid defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at main solenoid, Voltmeter negative black lead to black wire at main solenoid.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids defective, or accelerator micro switch defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to white wire at #1 tab terminal of speed control module, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids, or accelerator micro switch defective.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal. Voltmeter negative black lead to large side terminal at reverse solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from controller M - to reverse solenoid large side terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to S2 terminal at traction motor.	Full battery voltage = Good	If low or no voltage, replace defective reverse solenoid.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to small bottom terminal of forward solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from motor S-2 terminal, to forward solenoid small bottom terminal.
Key switch in forward, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to small top terminal of forward solenoid.	Full battery voltage = Good	Less than full battery voltage, replace defective forward solenoid.

Note: Always follow trouble shooting guide in exact order as listed below. Performing tests out of sequence will cause inaccurate results and lost time in diagnosing electrical system problems.

Vehicle Does Not Operate In Reverse, Operates Correctly In Forward		
Test	Passed	Failed
Voltmeter positive red lead to battery B+ terminal, Voltmeter negative black lead to battery B- terminal.	Full battery voltage = Good	Less than full battery voltage, charge and or replace batteries.
1. Key switch in forward. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal. 2. Key switch in reverse. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to battery negative (B-) terminal.	Full battery voltage = Good	Less than full battery voltage, check key switch and wire harness.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to yellow wire at reverse solenoid small terminal, Voltmeter negative black lead to black wire at forward solenoid small terminal.	Full battery voltage = Good	Less than full battery voltage, accelerator micro switch or micro switch circuit defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to red wire at forward solenoid small terminal, Voltmeter negative black lead to black wire at forward solenoid small terminal.	No Voltage = Good	Full battery voltage, diodes between forward and reverse solenoid defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to white wire at main solenoid, Voltmeter negative black lead to gray wire at main solenoid.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids defective or accelerator micro switch defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to white wire at #1 tab terminal of speed control module, Voltmeter negative black lead to controller B- terminal.	Full battery voltage = Good	Less than full battery voltage, diodes between forward and reverse solenoids, or accelerator micro switch defective.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal. Voltmeter negative black lead to large side terminal at reverse solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from controller M - to reverse solenoid large side terminal.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to small bottom terminal at forward solenoid.	Full battery voltage = Good	If low or no voltage, replace defective forward solenoid.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to traction motor S-1 terminal.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from forward solenoid small bottom terminal to motor S-1.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to small bottom terminal of reverse solenoid.	Full battery voltage = Good	If low or no voltage, check cables and cable connections from motor S-2 terminal, to reverse solenoid small bottom terminal.
Key switch in reverse, depress accelerator pedal. Voltmeter positive red lead to controller B+ terminal, Voltmeter negative black lead to small top terminal of reverse solenoid.	Full battery voltage = Good	Less than full battery voltage, replace defective reverse solenoid.

M-18 Drive System



Color Code	
BK	Black
BE	Blue
Y	Yellow
O	Orange
W	White
R	Red
All unspecified Cables are Black	



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